Scottish School-Book Association.

PROGRESSIVE SERIES.

THE

ADVANCED READER.

LESSONS

IN

LITERATURE AND SCIENCE.

WITH ILLUSTRATIONS.

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PREFACE.

The Advanced Reader, comprising Lessons in Literature and Science, is a sequel to Progressive Lessons, and will be found suitable as a highest English Class-Book for Academies as well as for Burgh and Parish Schools.

The Scientific part has been prepared with care and research, and detailed in a manner meant to be at once interesting, clear, and precise; each subject taken up being treated in an accurate and exhaustive manner, and the best and most recent authorities having in every case been consulted. Diagrams, which are but the most comprehensive and forcible of words, are copiously given as the best mode of explanation.

Though order and method are strictly observed, the Scientific and Literary Lessons are intermingled, so as to present an attractive variety to the pupil.

In the Literary Pieces, useful information and interesting detail have been the principles of selection. To teach the great knowledge of the True, the Beautiful, and the Good, by the assistance of the Master Minds of England, was considered an indispensable requisite here; and it is hoped that the Extracts in Poetry and Prose will be found, as far as the combination was possible, suitable reading for the young, and good specimens of the literature of our native land.

Modulation and Inflection receive special attention, for the world at large is becoming sensitive on the subject of good reading, and justly insists on this accomplishment as the primary element in any claim to scholarship.

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PRINCIPLES OF ELOCUTION.

THE following short Abstract of the Theory of Elocution may be found useful in imparting variety, emphasis, and grace, to Reading and Recitation. The rules of Inflection, Emphasis, Modulation, and Pausing, are accompanied with illustrative sentences chiefly extracted from the lessons of this collection.

INFLECTION.

Inflection regulates those slides of the voice which are natural and appropriate in certain constructions of sentences. The general rule of Inflection is, that the voice takes an upward slide at that part of a sentence where the sense is incomplete, and a downward where the sense is completed. A pupil who understands the nature of a principal and a secondary clause, will recognise the situations where a rising and a falling inflection should take place. In the sentence—"If he fail, he is lost," the rising slide occurs at "fail," and the falling at "lost." The propriety of inflection, however, may be recognised by the pupil more readily in words of Interrogation, Exclamation, and Command. Thus the pronunciation of the word "What!" in the language of strong surprise, may give a pupil an idea of the rising inflection; and the utterance of the word "March" in the tone of military command, will give an idea of the falling inflection. Both slides may be exemplified in these words, with the intervals of a third or a fifth.

TABLE OF INFLECTION.

The pupil may be taught to give inflection on letters, words, and clauses.

Is it A or B B or C D or E F or G &c.

Did he say late or late dine or dine &c. &c.

Is he sensible of the injury or insensible of it?

In the first exercise, the rise on "A" is continued without a pause on "or," and the voice begins to descend on "B." This is necessary, at first, to secure the fall on "B;" for if the voice of a beginner sinks on "or," the fall on "B" will be undecided and weak. The same method must be pursued with regard to the words "sensible of the injury or," which must follow the rise on "sensible" without a pause—if this practice of continuing the raised voice is not followed, the voice will in the pronunciation of such words as "of the injury or" have sunk so low as to be unable to give "insensible" the proportional fall to "sensible." And that the pupil may raise the voice easily on "A," he should be made to descend on "Is it"—thus giving what is called the Preparatory Slide. This table may be

practised with profit by a whole class—for in the first attempts at Inflection, pupils are disconcerted when they attempt it singly. Care must be taken that the pupil do not mistake loudness for height: it is a useful exercise to make a pupil give the rising inflection at times with gentleness, and the falling with force—the last, for instance, in such words as "March."

It is B not A C not B E not D &c.

He said late not late dine not dine &c.

He is sensible of the injury, not insensible of it.

In this table, it is necessary to have a preparatory rise on "It is," to fall on "B"—on "he said," to fall on "late," &c.—and "of the injury not" follows on the same tone as the fall on "sensible."

Were the pupil to be confined to this mode of inflection, the delivery would be stilted and unnatural; it is therefore necessary that the inflection should be varied and modulated. Thus—

Is he sensible of the injury,
or insensible of it?

The second clause beginning in a lower key.

Inflection also should be practised without the preparatory slide on the previous word. Thus—

He said lâte, not late.

Here the preparatory rise is on the word on which the fall terminates, viz., "late"—this mode of falling takes place on emphatic words, and is frequently indicated in books by the circumflex (∧).

RULES OF INFLECTION.

1. *The Rising Inflection is employed after questions introduced by verbs.* 2. *In exclamations of surprise, and in the echo of words.* 3. *Between the principal and secondary clause in a complex sentence.* 4. *Between the nominative and verb, if the nominative is an important word.* 5. *After the nominative when accompanied by adjuncts prepositional or limitingly relative.* 6. *After an infinitive mood when a nominative to a verb.* 7. *Between the parts of a compound sentence signifying concession, comparison, and contrast.* 8. *After the penultimate clause.* 9. *At the termination of the first line in verse, when the sense is completed in the second line.*

*1. *Cassius*—O gods, ye gods! must I endure all this?
2. *Brutus*—All this—ay more.
Othello—Is he (Cassius) not hónest?
Iago—Hónest, my lord?
Othello—Hónest? ay, honest?
Iago—My lord, for aught I know.
Othello—What dost thou think?
Iago—Thínk, my lord!

* It may be remarked here that if "or" gives two questions conjunctively, a rise takes place at the end of both—thus, "Was it Jóhn or Jámes?" that is, was it any one of them: if "or" separates or disjoins, a fall takes place on the last—thus, "Was it Jóhn or Jàmes?" meaning which one.

3. When danger darkened around his náme, she loved him the more ardently. Page 91.

4. Póetry is one of the great instruments of our happiness. Page 70.

5. The desperate state of our army abróad, is in part known. Page 115.

Music which has no óther aim, cannot be justified. Page 67.

6. To look on music as a mere amúsement, cannot be justified. Page 67.

7. There is doubtless a great difference in the constitution of indivíduals; but all mankind are endowed with the faculty of song. Page 67.

The telescope led me to see a system in every stár; the microscope leads me to see a world in every atom. Page 7.

8. In three campaigns we have done nóthing, and suffered much. Page 115.

9. A soldier of the Legion lay dying in Algíers,
There was lack of woman's nursing, there was dearth of woman's tears. Page 72.

The Falling Inflection takes place—1, at the end of a sentence—2, at the end of a clause forming sense of itself, except in a series—3, after exclamations of solemnity, admiration—and 4, after questions introduced by pronouns and adverbs.

1. Poetry is one of the great instruments of our hàppiness. Page 70.

In this sentence, the voice makes what is called a cádence, that the fall on "happiness" may not be violent like that of emphasis. In doing this, the voice sinks down after "poetry" into a lower key, ascends a little on "instruments," and comes down on "happiness" with a fall partaking little of the slide.

2. By a series of criminal énterprises, the liberties of Eúrope have been gradually extìnguished; and wè are the only people in the eastern hémisphere who are in possession of equal láws and a free constitùtion. Page 34.

I consider a human soul without education, like marble in the quàrry, which shows none of its inherent beauties till the skill of the polisher fetches out the colours, &c. Page 1.

Here the relative does not limit or modify the antecedent, therefore a fall takes place before it.

The fall on "extinguished" differs from that on "constitution"—the interval should be small, and should convey to the hearer that more is to be said—the fall on "constitution" proceeds from a cadence as mentioned above.

3. What a piece of work is màn! How noble in rèason!

4. Who shall resist me in a pàrent's cause?

SERIES.

A succession of single words in the same relation to other words in the sentence is called a Simple Series. If it commences the sentence, the last of the series requires a rise as the sense then begins to be formed; if it concludes, the one before the last requires a rise in order to anticipate the final fall.

He was tried, condèmned, and éxecuted, on a charge of treason.
Cromwell's energy was nàtural, héalthful, and tèmperate.

When the series consists of clauses bearing the same relation, it is called a Compound Series. If it commences a sentence, the falling inflection takes place on every member but the last; if it concludes, on every member except the one before the last.

These abominable prìnciples, and this more abominable avówal of them, demand the most decisive indignation. Page 116.

In her fàmily, in her còurt, in her kíngdom, Mary remained equally mistress.

Mary remained equally mistress in her fàmily, her cóurt, and her kingdom.

Such notions shock every precept of moràlity, every feeling of humánity, every sentiment of hònour. Page 116.

As Cæsar lóved me, I wèep for him; as he was fórtunate, I rejòice at it; as he was vàliant, I hónour him; but as he was ambítious, I slèw him.

In this last form of sentence, the speaker is supposed to anticipate the last clause. But in extempore speaking, especially in excitement, this artificial mode might not be adopted — thus, in the following sentence of Lord Brougham's:

Now, then, let the plànters beware—let their assèmblies beware —let the government at hòme beware—let the Pàrliament beware. Page 162.

This applies also to climax which falls under the series.

You are called upon as members of this hòuse — as mèn — as Chrìstians. Page 116.

EMPHASIS.

Emphasis is the stress which is laid on those words which are in opposition to, or contradistinction with each other. It is effected by force accompanied with inflection. If the emphatic word occurs in a declarative sentence, the falling inflection is used. The word opposed is sometimes expressed, sometimes understood. In the sentence—

Nàthan said unto Dávid, *Thòu* art the man.

"Thou" is the emphatic word, and the inflection on it is different from that on "Nathan," being more circumflex. Prominence is also given to the emphatic word by the light pronunciation of "art the man," as these words are common to both parts of the antithesis.

Brutus—Go, show your *slàves* how choleric you are.

Lady Macbeth—Give *mè* the daggers.

Approach and read (for *thòu* canst read) the lay
Graved on the stone, beneath yon aged thorn. P. 391.

Antithesis—I cannot read.

Such plays alone should please a British ear,
As Cato's *sèlf* would not disdain to hear.

Antithesis—As not only a person of nice morals would approve, but such as even a rigid moralist, like Cato, would approve. (WALKER.)

If the antithesis is expressed in a negative clause preceding the emphasis, it is given with the rising inflection.

Nelson has left us not merely a náme, but an *example.*

Emphatic words in questions asked by verbs, require a rise; by pronouns and adverbs, a fall.

Macbeth—Art thou not, fatal vision, sensible
To *feeling* as to sight? or art thou but
A dagger of the *mind?*

The reason of the fall on "mind" is, that the "or" is disjunctive.

Who shall resist me in a pàrent's cause?

A pronoun followed by a relative has a force anticipatory of the coming relative.

Hè cannot be said to have fallen prematurely, whose work was done. Page 51.

The emphasis is said to be double when four emphatic words occur.

Regions Caèsar never knéw,
Thy postérity shall swày. Page 6.

While *yòu* are engaged in the *field*, *mány* will repair to the *clòset.* Page 35.

Emphasis is often strengthened by the adoption of a lower key. This gives effect in climax.

You are called upon as members of this hoùse, as mén, as Christians.

"As Christians" is given in a lower key.

Ironical emphasis is given with an exaggerated circumflex of tone.

Proceed, Catiline, in your *honourable* career.

PAUSES.

Those clusters of words which do not come within the grammatical points, are separated by short pauses, and their inflection is regulated by the grammatical clause—thus, if there is a fall at the end of the grammatical clause, there is generally a rise at the pause before it, and vice versa.

By a series of criminal énterprises, the liberties of Eúrope' have been gradually extìnguished; and wè' are the only people in the eastern hémisphere who are in possession of equal láws' and a free constitution. Page 34.

These pauses, forming what some call oratorical words, occur between the nominative and verb, especially if the nominative is followed by a prepositional adjunct—in short intervening clauses—before prepositional clauses, if long—before infinitives not immediately preceded by a verb—at ellipsis—before clauses introduced by the conjunction "*that*," expressed, or

understood—and sometimes before a word to mark it out emphatically. Many of the preparatory slides take place at the close of these oratorical words. The marked pieces in this collection show the situation of those pauses, and render the giving of examples here unnecessary. It may be remarked here, that though there is generally a pause at the grammatical points, there are situations where no pause is made—thus, words of address are given without a pause, "I cannot, my lords, join in this address." There is no pause before "my lords."

PREPARATORY INFLECTION.

I consider a human soul without educátion, like marble in the quàrry, which shows nòne of its inherent beaúties| until the skill of the pólisher| fetches out the còlours, makes the surface shíne, and discovers every ornamental cloùd, spòt, and véin| that runs through the body of it.

The inflections in the above sentence are all within the rules already given, but preparatory slides might be added.

I consíder a human sòul without educátion, like márble in the quàrry, which shows nòne of its inherent beaúties| until the skìll of the pólisher| fétches out the còlours, makes the sùrface shíne, and discóvers every ornamental cloùd, spòt, and véin| that rúns through the bòdy of it.

The words between these inflections follow without a pause the inflection of the previous word—thus, "in the" follow "marble" as if the whole were spoken márbleinthe, and "of the" after "skill," follow in the slide of "skill" as if it were skillofthe; "through the" after "runs," as if it were runsthroughthe; and "of it" after "body" as if it were bodyofit, forming in sound one word.

MODULATION—SHIFT OF THE VOICE.

The variety of modulation within a sentence has been marked out in forming a cadence. The parenthesis, the modifying clause, the simile, and the second clause in an antithesis, also require a varied tone. The parenthesis is generally lower; the modifying clause lower at the commencement, but rising towards the termination; the simile, generally lower. In answering questions also, a lower key is assumed after a pause.

Approach and read (*for thou canst read*) the lay
Graved on the stone, beneath yon aged thorn. P. 391.

A man conspicuous in a high station, *who multiplies hopes that he may multiply dependents*, may be considered as a beast of prey.

Philòsophy| makes us wíser; *Christiánity| makes us bètter men.*

Has the dark ádder venom? *So have 'I when trod upon.*

Intervening clauses, especially when antithetic, pathetic, or prompted by passion, require a marked change of key.

I knew the eye, *though faint its light*, that once so brightly shone—
I knew the voice, *though feeble now*, that thrilled with every tone—
I knew the ringlets, *almost grey*, once threads of living gold. P. 388.

He smote me on the cheek—*I did not stab him,*
That were poor revenge. E'er since, his folly
Hath striven to bury it beneath a heap
Of kindnesses—and thinks it is forgot:
Insolent thought! and like a second blow.

A grand conception, a striking thought, or a desire in the speaker to arrest the attention of his audience, leads to a change of key.

Will all great Neptune's ocean wash this blood
Clean from my hand? No, this my hand will rather
The multitudinous sea incarnadine,
Making the green, *One Red.*

Ships, *by thousands,* lay below,
And men, *in nations.* Page 342.

In all the clauses in Italics a lower key is adopted, except "insolent thought," which is higher and louder. "He smote me on the cheek" is high and loud.

In the succession of sentences, there is frequently assumed a different key. A second sentence following a general remark, if giving a number of particulars illustrating that remark, begins a lower key. The beginning of a new paragraph also often commences in a lower key. The representation of the varied play of passion cannot be given without frequent shifts of the voice.

MONOTONE.

The monotone is at times well fitted to express impressions of solemnity, sublimity, and admiration. It is marked out by horizontal lines.

O Thōu that rūlest abōve, roūnd as the shiēld of my fáthers—whence are thy beams, O sun, thy everlasting líght?

IMITATIVE MODULATION.

This modulation is only adopted in lively and poetic pieces. It is given in such words as whirl, dash, pour, crash, clash, boil.

In the notation of the following lessons, the emphatic words are marked with the common signs of inflection. The judgment of the teacher will guide the pupil in distinguishing the words which should have emphatic force. It may be stated also, that the preparatory slide is frequently marked out, that the monotonous mode of reading between the grammatical slides may be prevented.

THE ADVANCED READER.

PART I.

SECTION I.

EDUCATION.

[JOSEPH ADDISON was the son of a clergyman. He was born at Milston, Wiltshire, in the year 1672, and died at Holland House in 1719. He received the rudiments of education at Salisbury and Lichfield, and was afterwards sent to the Charter-house, where he contracted his first intimacy with Mr., afterwards Sir Richard Steele. His great success at the university of Oxford, the friends he had formed, and the elegance of his accomplishments, brought him early into the sphere of fortunate patronage. Addison and his friend Steele contributed the greater portion of the papers in the "Tatler," the "Spectator," and the "Guardian." In 1713 the production of his tragedy of "Cato" was the "grand climacteric of Addison's reputation." As a prose writer, he holds the first rank for elegance and purity of style. Dr. Johnson has justly remarked—"Whoever would attain an English style, familiar but not coarse, and elegant but not ostentatious, must give his days and nights to the volumes of Addison."]

I CONSÍDER a human sòul without educátion, like márble in the quàrry, which shows none of its inherent beáuties' until the skìll of the pólisher' fetches out the còlours, makes the surface shíne, and discovers every ornamental cloùd, spòt, and véin' that runs through the bòdy of it. Educátion, after the sàme manner, when it works upon a noble mínd, draws out to vièw' every latent virtue and perféction, which, withóut such helps, are never áble to make their appeàrance.

If my reader will give me léave' to chànge the allusion so sóon upon him, I shall make use of the sàme instance' to illustrate the force of educátion, which Arìstotle has brought' to explain his dóctrine of substantial fòrms, when he télls us' that a stàtue lies híd in a block of màrble, and that the art of the státuary' only clears away the superfluous mátter' and removes the rùbbish. The figure is ín the stone, and the scúlptor' only finds it. What scùlpture is' to a block of márble, educátion is' to a human soùl. The philósopher, the

saínt, or the hèro—the wìse, the goòd, or the gréat man—very often lies hid and concealed in a plebèian, which a proper education might have disintérred, and have brought to lìght. I am therefore much delíghted| with reading the accounts of sàvage nations, and with contemplating those vírtues| which are wíld and uncùltivated; to see coúrage| exerting itself in fièrceness, resolútion| in òbstinacy, wìsdom| in cúnning, pátience| in sullenness and despàir.

It is an unspeakable blèssing| to be born in those parts of the wórld| where wisdom and knowledge floùrish; though it must be conféssed| there are, even in thèse parts, several poor uninstructed pérsons, who are but lìttle above the inhabitants of those nátions| of which I have been here spèaking; as those who have had the advantages of a more liberal educátion, rise abóve one another| by several different degrèes of perfection. For, to retùrn to our statue in the block of márble, we see it sómetimes| only begun to be chìpped; sòmetimes| rough-héwn, and but just sketched into a human fìgure; sométimes| we see the man appearing distínctly| in all his limbs and fèatures; somètimes| we find the figure wrought up to great élegancy; but seldom meet with ány to which the hand of a Phidias or a Praxíteles| could not give several nice toúches and finishings.

ADDISON.

HEROISM OF A PHYSICIAN.

THE plague raged violently in Marseilles (1630). Every link of affection was broken; the father turned from the child, the child from the father: ingratitude no longer caused indignation. Misery is at its height when it thus destroys every generous feeling. The city became a desert; grass grew in the streets; a funeral met you at every step. The physicians assembled in a body to hold a consultation on the fearful malady, for which no cure had yet been discovered. After a long deliberation, they decided that the malady had a peculiar and mysterious character, which

could only be found out by opening a corpse—an operation which it was death to attempt, since the operator must infallibly fall a victim in a few hours, beyond the power of human art to save him. A dead pause succeeded this fatal announcement. Suddenly a surgeon named Guyon, in the prime of life, and of great celebrity in his profession, rose and said firmly, "Be it so: I devote myself for the sake of my country. To-morrow, at the break of day, I will dissect a body, and write down as I proceed what I observe." Guyon acted up to his words. He had never married; he was rich; and he immediately made a will, dictated by justice and piety. A man had died of the plague in his house within four-and-twenty hours. Guyon, at day-break, shut himself up in the same room, taking with him pens, ink, and paper. He began and finished the dreadful operation, and wrote in detail his surgical operations. He then left the room, placed the papers into a vase of vinegar, and afterwards sought the lazaretto, where he died in twelve hours—a death ten thousand times more glorious than that of the soldier, who, to save his country, rushes on the ranks of the enemy.

MADAME DE GENLIS.

VALUE OF TIME.

SUFFER me to impress upon you the importance of a just estimate of time. Consider how much is to be performed, attained, and conquered, ere you are fitted to discharge the duties which your sphere may comprehend. Think of the brevity of life. The most aged have compared it to a span in compass, and to a shuttle in flight. Compute its bearings upon the bliss or woe of eternity, and remember, if misspent, it can never be recalled. Other errors admit of reformation. Lost wealth may be regained by a course of industry; the wreck of health repaired by temperance; forgotten knowledge restored by study; alienated friendship soothed into forgiveness; even forfeited reputation won back

by penitence and virtue. But who ever again looked upon his vanished hours—recalled his slighted years, and stamped them with wisdom—or effaced from Heaven's record the fearful blot of a wasted life?

The waste of time in youth is a greater evil than at any other period of existence. "The misimprovement of youthful days is more than the mere loss of time. Figure to yourself what the year would sustain were the spring taken away: such a loss do they sustain who trifle in youth."

When there is so much to be done for individual improvement, in the formation of correct habits, and preparation for untried duty—so much for parents and benefactors, to pay even imperfectly the debt of gratitude—so much for brothers, and sisters, and friends—so much for the poor, the uneducated, the afflicted—so much in obedience to Him who hath commanded us to "work out our own salvation with fear and trembling"—how unreasonable is it to do but little, and to do that little carelessly! how sinful to trifle away our time in light amusement, or profitless pursuit! It is no excuse for us, that others devote their days to desultory pleasures, or pass their youth without motive and without improvement. Every one must stand *alone* to give an account at last. The example of an associate will not be accepted as a palliation; nor will the habit of excuse, however it might have deceived men, justify us before a Judge who readeth the intents of the heart.

The successful improvement of time is aided by order in its distribution. A division of the day into parts facilitates the successful discharge of its duties. Many of those who have become eminent in science and literature have adhered to a systematic arrangement of time. King Alfred, who so remedied the defects of early education as to gain distinction in the field of intellect, as well as in the annals of royalty, was an example of regularity. He divided the twenty-four hours into three equal portions. One of these periods of eight hours was devoted to the duties of religion; one to repose, recreation, and literature; and the other to the cares of his realm. Sir William Jones, who acquired

the knowledge of twenty-eight languages, and whose attainments in all that ennobles man were such, that it was pronounced a happiness to his race that he was born, persevered in a regular allotment of his time to particular occupations, and a scrupulous adherence to the distribution which he had established. Thus his great designs went on without confusion, and so convinced was he of the excellence of daily system, and so humble in the estimation of his native endowments, that to the inquiry how his wonderful attainments had been made, he was accustomed to reply —"*Only by industry and regular application.*"

SIGOURNEY.

BOADICEA.

[WILLIAM COWPER was the son of a clergyman of good family. He was born at Berkhamstead, Herefordshire, in 1731, and died in 1800. Through the influence of his family he was appointed to the valuable and honourable situation of Clerk to the House of Lords; but his nervousness and timidity were such, that he was obliged to resign it. Although his mind was frequently assailed by gloom, and bent down by despondency, he was not only a very voluminous writer, but a poet of first-rate merit. In addition to translating Homer, he wrote "The Task"—the best of all his poems, "Tirocinium," and a host of smaller pieces.]

When the British warrior queen,
  Bleeding from the Roman róds,
Sought, with an indignant mien,
  Counsel of her country's góds:

Sage! beneath the spreading óak!
  Sat the Drúid, hoàry chief;
Every burning word he spóke,!
  Full of ráge, and full of grièf.

Princess! if our aged eyes!
  Weèp upon thy matchless wróngs,
'Tis because reséntment! ties
  All the terrors of our tòngues.

Róme! shâll pèrish—write that wórd
In the bloòd that she has spilt;
Pérish, hòpeless and abhórred,
Deep in rúin! as in gùilt.

Rome, for empire far renówned,
Tramples on a thousand stàtes;
Soon her pride shall kiss the groùnd—
Hàrk! the Gaùl is at her gates!

Òther Romans! shall aríse,
Heedless of a sòldier's name;
Soùnds, not árms, shall win the prize,
Hàrmony! the path to fame.

Then the progeny that springs
From the forests of our lánd,
Armed with thùnder, clad with wíngs,
Shall a wìder world command.

Regions! Cæ̀sar never knéw!
Thy postérity! shall swày;
Where his èagles! never fléw,
None invíncible as thèy.

Such! the bard's prophetic wórds,
Pregnant with celestial fire,
Bending! as he swept the chórds
Of his swéet! but àwful lyre.

Shè, with all a monarch's príde,
Félt them! in her bòsom glow;
Rushed to bàttle, foúght, and dièd;
Dýing! hùrled them at the foe.

Rùffians, pitiless as próud,
Heàven! awárds the vengeance dùe;
Èmpire! is on ús bestowed,
Shàme and rúin! wait for yòu.

COWPER.

THE TELESCOPE AND MICROSCOPE.

[REV. DR. THOMAS CHALMERS was born at Anstruther, in Fife, in the year 1780, and died in 1847. He was early sent to the University of St. Andrews, and it was there that his passion for the physical sciences was first developed. On being licensed to preach, he was first minister of Kilmany, and then of the Tron Church of Glasgow. In 1824 he accepted the chair of moral philosophy at St. Andrews; in 1838 he was removed to the chair of theology in the University of Edinburgh; and at the "Disruption" in 1843, he joined the Free Church, and became principal and professor of theology to the seceding body. Chalmers was one of Scotland's greatest and most eloquent divines. In him we see one great by intellectual power, great by sanctified attainments—one on whose like Scotland will not soon look again.]

ABOUT the time of the invention of the télescope, anòther instrument was formed, which laid open a scene no less wónderful, and rewarded the inquisitive spirit of màn. Thís| was the mìcroscope. The òne| led me to see a sỳstem in every stár; the óther| leads me to see a wórld in every àtom. The òne| taught me that this mighty globe, with the whole burden of its people and its cóuntries, is but a grain of sànd on the high field of imménsity; the óther teaches me| that every grain of sànd| may harbour withín it| the tribes and the families of a busy populàtion. The òne| told me of the insignificance of the world I tréad upon; the óther| redèems it from all its insignificance; for it télls me| that in the leaves of every fòrest, in the flowers of every gàrden, and in the waters of every rívulet, there are worlds teeming with lífe, and as númberless| as are the glories of the firmament. The òne| has suggested to me| that beyónd and abòve all that is visible to mán, there mày be fields of creátion which sweep immeàsurably along, and carry the impress of the Almighty's hand| to the remòtest scenes of the úniverse; the óther| suggests to me| that withín and beneàth all that minuteness, which the aided eye of man has been able to explóre, there may be anòther region of invìsibles; and that, could we draw aside the mysterious cùrtain| which shrouds it from our sénses, we might see a theatre of as many wónders as astrònomy has unfolded—a úniverse| within the compass of a point so smáll, as to eludé all the powers of the mìcroscope, but where the wonder-working God| finds room for

the exercise of àll His attributes, where He can raise anóther mechanism of worlds, and fill and animate them áll' with the evidence of His glòry.

CHALMERS.

TO THE RAINBOW.

TRIUMPHAL arch, that fill'st the sky
When storms prepare to part,
I ask not proud Philosophy
To teach me what thou art.

Still seem as to my childhood's sight,
A midway station given—
For happy spirits to alight
Betwixt the earth and heaven.

Can all that Optics teach, unfold
Thy form to please me so,
As when I dreamt of gems and gold
Hid in thy radiant bow?

When Science from creation's face
Enchantment's veil withdraws,
What lovely visions yield their place
To cold material laws!

And yet, fair bow, no fabling dreams,
But words of the Most High
Have told why first thy robe of beams
Was woven in the sky.

When o'er the green undeluged earth
Heaven's covenant thou didst shine,
How came the world's grey fathers forth,
To watch thy sacred sign!

And when its yellow lustre smiled
O'er mountains yet untrod,
Each mother held aloft her child
To bless the bow of God.

Methinks thy jubilee to keep,
The first made anthem rang,
On earth delivered from the deep,
And the first poet sang.

Nor ever shall the Muse's eye,
Unraptured greet thy beam:
Theme of primeval prophecy,
Be still the poet's theme.

The earth to thee its incense yields,
The lark thy welcome sings,
When glittering in the freshened fields,
The snowy mushroom springs.

How glorious is thy girdle cast
O'er mountain, tower, and town!
Or mirrored in the ocean vast
A thousand fathoms down!

As fresh in yon horizon dark,
As young thy beauties seem,
As when the eagle from the ark
First sported in thy beam.

For faithful to its sacred page,
Heaven still rebuilds thy span,
Nor lets the type grow cold with age
That first spoke peace to man.

CAMPBELL.

NATURAL HISTORY.—MINERALS.

Acid, (*acidus*, L.) *Lit.* a substance with a sour, pungent taste.*
Amorphous, (*a*, *morphe*, G.) without definite or regular shape.
Base, (*basis*, G.) *Lit.* the foundation; the leading ingredient. Hence *basic*.
Botany, (*botane*, G.)*
Carbon, (*carbo*, L.) Hence *carbonic acid* and *carbonate* (a salt containing carbonic acid).
Crystal, (*crystallos*, G.) Hence *crystallize* and *crystallization*.
Cube, (*cubos*, G.)
Equilateral, (*aequus*, *latus*, L.) equal-sided.
Graphite, (*grapho*, G.)
Mineralogy, (*logos*, G.)
Nitrogen, (*nitron*, *gennao*, G.) *Lit.* producer or generator of nitre.
Octahedron, (*octo*, *hedra*, G.)
Organ, (*organon*, G.) Hence *organic*, *inorganic*, *organized*, *organization*, *organism*.
Oxygen, (*oxys*, *gennao*, G.) *Lit.* producer or generator of acids.
Parallelogram, (*para*, *allēlōn*, *gramma*, G.) a four-sided figure, whose opposite sides are parallel, *i.e.*, extend in the same direction.
Prism, (*prisma*, G.)
Silica, (*silex*, L.) *Lit.* the earth of flints. Hence *silicon* or *silicium*, *silicious*.
Zoology, (*zoön*, *logos*. G.)

* When the ordinary meaning of a word is sufficiently explained in the text of the lessons, the explanation is not repeated in the Vocabularies.

OBJECTS AND DIVISIONS OF NATURAL HISTORY.

If we look around us, we shall find that our world, the habitation which God has given us, is full of the most beautiful and interesting objects. Animals, in countless thousands, roam over the earth, soar into its atmosphere, or disport themselves in its waters. It produces an immense number of plants, which contribute alike to its comfort and elegance as the abode of man. Nor are the materials, of which the earth itself is composed, less worthy of our attention. Human skill and labour have penetrated far beneath its surface, and thence, from stores that seem to be inexhaustible, have extracted much that is useful, and much also that is wonderful.

Surely it is right and becoming that we should have some intelligent acquaintance with what is thus presented to our notice. We can, indeed, scarcely help inquiring into the nature of those things which interest us, just as the child wishes to know the construction of his plaything, and will even tear it to pieces to gratify his curiosity. But it is not curiosity alone which prompts our inquiries into the objects and processes of nature. Such inquiries are profitable as well as pleasing; they give us the means of increasing our comforts, and of alleviating our ills; they expand and elevate

our minds, and lead us to the contemplation of that Great Being by whom all things exist.

That we may not be bewildered by the endless variety of nature's productions, it is necessary to arrange them into groups or classes, according to their several properties. Each group is then subdivided into several smaller ones, and these are again subdivided as often as may be necessary. In this way we obtain a system of *classification*, to which each individual object, whether animate or inanimate, may be referred, and its place correctly ascertained.

To classify thus all the objects which exist in nature, and to describe their appearance, structure, properties, and uses, is the business of NATURAL HISTORY.

Some bodies are made up of parts different from each other, which serve as instruments for performing certain processes or functions serviceable to the whole body. For example, a man has eyes for seeing, lungs for breathing, and feet for walking. In the same manner a tree has roots, branches, leaves, &c., all performing their appropriate functions. Such parts are called *organs*, and those bodies that possess them are said to be *organized*. Organized bodies are of two kinds:—*Animals*, which are endowed with the powers of sensation and voluntary motion; and *Vegetables*, or *Plants*, which are destitute of those powers. Plants, as well as animals, may be regarded as, in one sense, living creatures.

It will easily be perceived that stones, metals, earths, &c., have no organs; they are therefore said to be *inorganic*. Inorganic bodies are also called *Minerals*, because many of the most important of them are dug out of mines.

Thus the science of Natural History falls into three great divisions, corresponding to the three great classes, or (as they are usually termed) kingdoms, in which the objects of nature may be arranged. They are:—

I. *Mineralogy*, which treats of the *Mineral Kingdom;*
II. *Botany*, which treats of the *Vegetable Kingdom;*
III. *Zoology*, which treats of the *Animal Kingdom.*

FORM AND STRUCTURE OF MINERALS.

It has been said that minerals are distinguished both from plants and animals by being destitute of organization. They therefore undergo none of those processes which organs are intended to carry on. A stone does not *grow;* if it increases in size, it can only be by the addition or aggregation, from without, of matter similar to that of which it is composed. But plants and animals grow from within, by adopting new matter into their organic system, and thereby developing their own parts and members. Again, there appears to be no definite or necessary limit to the time during which a stone may continue to exist. Organized bodies, on the other hand, after giving birth to others of the same species, gradually decay and die.

Nearly all mineral substances are solid. Mercury, however, one of the metals, is usually in a fluid state, though it can be solidified, or frozen, by exposure to intense cold. Water itself is sometimes reckoned a mineral substance.

Some minerals consist of minute particles simply collected together, with no regularity of structure, or constancy of external form. These are said to be *amorphous.* But by far the greater number seem to have their particles arranged according to some definite law, and are found to assume, under favourable circumstances, more or less regular geometrical forms, bounded, for the most part, by plane surfaces and straight lines. Such forms are called *crystals,* and the substances composing them are said to be *crystallized.* The word crystal originally included the idea of clearness or transparency; but, in speaking of minerals, that notion must be at once dismissed. It is applied to a solid body, whether transparent or opaque, which exhibits naturally (that is, without being cut or moulded in any way by man's instrumentality) a certain regularity of shape. Among the simpler forms of crystallization are the *cube* (fig. 1), a well-known solid, of which we have an example in dice; the *octahedron* (fig. 2), with eight faces, each of which is an equilateral triangle; and the *prism* (figs. 3 and 4), which

has two equal and similar ends, and whose other faces are parallelograms. Other forms are almost innumerable, and some of them are extremely complex. Sugar-candy, though it does not belong to the mineral kingdom, may be mentioned as a familiar example of a crystallized substance. In loaf-sugar, the crystallization is less obvious, but still distinctly visible.

FIG. 1.

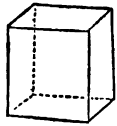
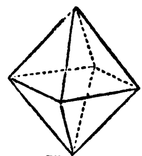


FIG. 2.



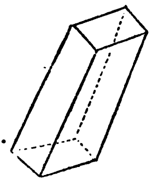


FIG. 3.

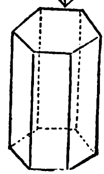


FIG. 4.

Many substances can be crystallized by artificial means; as, for example, by allowing them to cool slowly after being melted, or by dissolving them in water, and leaving the solution gradually to evaporate. But we are ignorant, as yet, of the means by which the majority of crystals belonging to the mineral kingdom are produced. Natural crystals of quartz have been found of an immense size; one in the Museum at Paris measures no less than three feet in diameter. Carbonate of lime crystallizes in an incredible variety of forms. But the most beautiful of known crystals is the diamond; it consists of pure carbon, the same substance which appears, in its amorphous state, as lampblack, soot, or charcoal, and is then by no means remarkable for its beauty.

How wonderful the facts thus brought before us! Whence, we may well ask, this order and regularity? Whence did the lifeless particles of matter derive the property of arranging themselves in mathematical forms? Have we not here a striking illustration of the strange yet true remark, that the Creator, in constructing and regulating the material universe, "works by geometry."

COMPOSITION OF MINERALS.

Those substances which men of science have not been able to decompose, are in the meantime regarded as *simple* or *elementary*. Their number is about sixty; but it is probable that some of these may hereafter be shown to be compound. All of them occur in the mineral kingdom, either separately or in combination; but not more than twenty are common, and only about twelve abundant. *Carbon*, *sulphur*, and a few of the metals, are found pure; the first in two distinct and very dissimilar forms—diamond, and graphite or plumbago, of which pencils are made. *Oxygen* and *nitrogen* are mixed together, but not combined, in atmospheric air. The rest are always combined with these, or with one another.

Simple substances usually unite in pairs, and by their union form compounds, whose qualities are often very different from those of either element. The new substance thus produced may again unite, either with a third element, or with another compound. Again, the same substances may be combined in several different proportions, and form a series of compounds with little or no resemblance to each other. Thus it is that the objects of nature, though the number of their elementary ingredients is comparatively small, assume that wondrous variety of character and appearance, by which they are so well fitted to charm the eye, as well as to promote the comfort and convenience of man.

The most extensively diffused of all the recognised elements is *oxygen*, a gaseous substance, without colour, smell, or taste. Besides being essential to the existence of all organized bodies, it is a principal ingredient of the atmosphere and the ocean, and enters into the composition of the more abundant minerals. The sand of the desert, and the soil of the cultivated field, alike owe some of their qualities to its presence; it is found in the rugged granite and the finest marble, in the shapeless clay and the glowing sapphire; it feeds the flames in our grates, and glitters in the frozen glaciers; without it, every plant would droop, and every

animal die. Oxygen forms compounds with nearly all the elementary substances. These compounds are known by the general name of *oxides*, and are divided into two classes, *acids* and *bases*, whose qualities are in many respects opposite to each other. Sometimes a third class is reckoned, including those which do not exhibit acid or basic properties, and are therefore denominated *neutrals*. An acid and a base have generally a strong tendency to enter into combination, and when they do so, the compound formed by them is called a *salt*. Both oxides and salts are of very frequent occurrence, and of the highest importance, in the mineral kingdom.

Carbon, besides being found pure (as already stated), and in the form of salts called *carbonates*, is the main constituent of the various species of Coal—a substance of more value to mankind than either gold or diamonds. Fortunately for the progress of science and civilization, coal is found in enormous quantities, and very widely distributed over the earth. It is almost needless to speak of the blessings of which it is the fertile source. By it our hearths are cheered and enlivened, our food rendered palatable, and the severity of our climate mitigated. We extract from it the gas which lights up our streets, our churches, our public buildings, and our homes. Its use is indispensable in many of the arts; and, in particular, it is the chief agent in the production of steam, the grand wonder-worker of our age.

Silicon, or *Silicium*, occurs chiefly in the form of an oxide, called *silica*, which is one of the most abundant substances in nature. Rock crystal consists of silica almost in a state of purity; it is less pure, but still the principal ingredient, in common quartz, agate, calcedony, flint, and several other minerals. It is largely disseminated in those stupendous piles of gneiss and granite, of which our sublimest and most gigantic mountains are composed, and contributes not a little to that hardness which enables them to resist alike the disintegrating influence of frost, and the constant wear of streams, produced by the melting of the snow in which their summits are enveloped. The mobile soil of the desert,

rolling with the wind like the waves of the sea, is mainly composed of silicious matter, reduced to the form of sand; and this sand, when again cemented into a compact form, furnishes to the builder the valuable sandstone, of which whole cities are sometimes built.

All the elements which have been mentioned, and a few others, are *non-metallic.* The *metals* are a much more numerous class, some of the more important of which will form the subject of future lessons.

QUESTIONS FOR EXAMINATION.

Of what subjects does natural history treat? What benefits do we derive from the study of it? Why, and how, are the objects of nature classified? What is an organ? Name and distinguish two classes of organized bodies. What are minerals? Name the three great divisions of natural history. How does a mineral differ from an organized body in respect of growth? and of decay? Give examples of fluid minerals. When are bodies said to be amorphous? What is a crystal? Describe some of the most common forms of crystals. Give an example of a crystallized substance. How are crystals produced artificially? What is meant by an elementary substance? How many are at present known? Which of them are found pure in nature? Which is most widely diffused? What is an oxide? an acid? a base? a salt? In what substance is carbon abundant? What is silica? Name substances containing silica. In which is it nearly pure?

LADY LILLICRAFT'S RETINUE.

In the fírst place, her ládyship has a pampered coàchman, with a red fáce, and chéeks| that hang down like dèw-laps. He evidently dòmineers over her a líttle| with respect to the fat hòrses; and only drives oùt| when he thinks próper, and when he thínks| it will be "good for the càttle."

She has a favourite páge| to attend upon her pèrson—a handsome bóy of about twelve years of àge, but a mischievous vàrlet, very much spóiled, and in a fair way to be a good-for-nòthing. He is dressed in grèen, with a profusion of gold córd and gilt bùttons about his clothes. She always has óne or twò attendants of the kind, who are replaced by óthers| as soon as they grow to fourteen years of àge.

She has brought two dògs with her also, out of a number of péts| which she maintains at hòme. One is a fat spàniel, called

Zèphyr. He is fed out of shápe and comfort; his eÿes| are nearly strained out of his hèad; he wheezes with córpulency, and cannot wálk without great dìfficulty. The óther is a lìttle, òld, grey-muzzled curmúdgeon, with an unhappy eÿe, that kindles like a cóal, if you only loòk at him; his nóse turns ùp; hìs mouth is drawn into wrínkles, so as to show his teèth; in shòrt, he has altogether the look of a dog far gone in misánthropy, and totally sìck of the world. When he wálks, he has his tail curled up so tíght, that it seems to lift his feet from the gròund; and he seldom makes use of more than thrèe legs at a tíme, keeping the óther drawn up as a resèrve. This lást wretch| is called Beàuty!

These dogs are full of elegant áilments| unknown to vùlgar dogs, and are petted and nursed by Lady Líllicraft| with the tenderest kìndness. They are pampered and fed with délicacies| by their fellow-mínion, the pàge; but their stomachs are often weak and out of órder, so that they cannot eàt; though I have now and then seen the páge| give them a mischievous pìnch, or thwack over the héad, when his mìstress was not by. They have cùshions for their express use, on which they lie before the fìre, and yet are apt to shiver and móan, if there is the least draught of aìr. When any one enters the róom, they make a most tyrannical bárking| that is absolutely deàfening. They are ínsolent| to all the òther dogs of the establishment. There is a noble stàg-hound, a great favourite of the sqúire's, who is a prìvileged visitor to the parlour; but the moment he makes his appéarance, these intruders fly át him| with furious ràge; and I have admired the sovereign indifference and contémpt| with which he seems to look dówn| upon his puny assàilants. When her ladyship drives óut, these dogs are generally cárried with her to take the aìr; and then they look out of each window of the cárriage, and bark at all vulgar pedèstrian dogs. These dógs| are a continual source of mísery to the hoùsehold; as they are always in the wáy, they every now and then get their tòes trod on, and thén| there is a yélping on theìr part, and a lamentàtion on the part of their místress, that fills the róom with clamour and confùsion.

Lástly, there is her ladyship's waiting-woman, Mrs. Hànnah, a prìm, pragmàtical old máid, whose every word and lóok| smacks of vèrjuice. She is the very òpposite to her místress, for the òne hátes, and the óther lòves all mankind. How they fìrst cáme together| I cannot imàgine; but they have líved together for many yèars; and the Ab'igail's temper being tart and encròaching, and her làdyship's| easy and yiélding, the fòrmer has got the complete upper hánd, and tỳrannizes over the good lády in sècret. Lady Lillicraft now and then complàins of it, in great confidence, to her fríends, but hushes ùp the subject immediátely, if Mrs. Hannah makes her appèarance. Indeèd, she has been so accùstomed to be atténded by her, that she thínks| she could not do withòut her; and the one great study of her lífe| is, to keep Mrs. Hannah in good húmour| by little presents and kìndnesses.

WASHINGTON IRVING.

LONDON AND ITS FOOD.

If, early on a summer morning, before the smoke of countless fires had narrowed the horizon of the metropolis, a spectator were to ascend to the top of St. Paul's, and take his stand upon the balcony, that with gilded rail flashes like a fringe of fire on the summit of the dome, he would see sleeping beneath his feet the greatest camp of men upon which the sun has ever risen. As far as he could distinguish by the morning light, he would behold stretched before him the mighty map of the metropolis; and could he ascend still higher, he would note the stream of life overflowing the brim of hills which enclose the basin in which it stands.

In the space swept by his vision would lie the congregated habitations of two millions and a half of his species,—but how vain are figures to convey an idea of so immense a multitude! If Norway, stretching from the Frozen Ocean

down to the southern extremity of the North Sea, were to summon all its people to one vast conclave, they would number little more than half the souls within the London bills of mortality. Switzerland, in her thousand valleys, could not muster such an army; and even busy Holland, within her mast-thronged harbours, humming cities, and populous plains, could barely overmatch the close-packed millions within sound of the great bell at his feet.

As the spectator gazed upon this extraordinary prospect, the first stir of the awakening city would gradually steal upon his ear. The rumbling of wheels, the clang of hammers, the clear call of the human voice, all deepening by degrees into a confused hum, would proclaim that the mighty city was once more rousing to the labour of the day; and the blue columns of smoke climbing up to heaven would intimate that the morning meal was at hand. At such a moment the thought would naturally arise in his mind,—In what manner is such an assemblage victualled? By what complicated wheels does all the machinery move by which two millions and a half of human beings sit down day by day to their meals as regularly and quietly as though they only formed a snug little party at Lovegrove's on a summer's afternoon? As thus he mused respecting the means by which the supply and demand of so vast a multitude are brought to agree, so that every one is enabled to procure exactly what he wants, at the exact time, without loss to himself or injury to the community, thin lines of steam, sharply marked for the moment, as they advanced one after another from the horizon and converged towards him, would indicate the arrival of the great commissariat trains, stored with produce from all parts of these isles and from the adjacent continent. Could his eye distinguish in addition the fine thread of that far-spreading web which makes London the most sensitive spot on the earth, he would be enabled to take in at a glance the two agents—steam and electricity—which keep the balance true between the wants and the supply of London.

The inability of figures to convey an adequate impression to the mind of the series of units of which the sums are

composed, renders it impossible to give more than a faint idea of the enormous supplies of food required to victual the capital for a single year. But the conception may be somewhat assisted by varying the process. Country papers now and then astonish their readers by calculations to show how many times the steel pens manufactured in England would form a necklace round their own little town, or how many thousand miles the matches of their local factory would extend if laid in a straight line from the centre of their market-place. Let us try our hand on the same sort of picture, and endeavour to fill the eye with a prospect that would satisfy the appetite of the far-famed Dragon of Wantley himself.

If we fix upon Hyde Park as our exhibition-ground, and pile together all the barrels of beer consumed in London in a single year, they would form a thousand columns not far short of a mile in perpendicular height.

Let us imagine ourselves on the top of this tower, and we shall have a look-out worthy of the feast we are about to summon to our feet. Herefrom we discover the Great Northern Road stretching far away into the length and breadth of the land. Lo! as we look, a mighty herd of oxen, with loud bellowing, is beheld approaching from the north. For miles and miles the mass of horns is conspicuous winding along the road, ten abreast, and even thus the last animal of the herd would be seventy-two miles away, and the drover goading his shrinking flank considerably beyond Peterborough. On the other side of the park, as the clouds of dust clear away, we see the Great Western Road, as far as the eye can reach, thronged with a bleating mass of wool, and the shepherd at the end of the flock (ten abreast), and the dog that is worrying the last sheep, are just leaving the environs of Bristol, one hundred and twenty-one miles from our beer-built pillar. Along Piccadily, Regent Street, the Strand, Fleet Street, Cheapside, and the eastward Mile End Road line, for seven and a half miles, street and causeway are thronged with calves (still ten abreast), and in the great parallel thoroughfares of Bays-

water Road, Oxford Street, and Holborn, we see nothing for nine long miles but a slowly-pacing, deeply-grunting herd of swine. As we watch this moving mass approaching from all points of the horizon, the air suddenly becomes dark—a black pall seems drawn over the sky; it is the great flock of birds (game, poultry, and wild-fowl) that are come up to be killed. As they fly wing to wing, and tail to beak, they form a square, whose superficies is not much less than the whole enclosed portion of St. James's Park, or fifty-one acres. No sooner does this huge flight clear away than we behold the park at our feet covered with hares and rabbits. Feeding two thousand abreast, they extend from the marble arch to the round pond in Kensington Gardens—at least a mile.

Let us now pile up all the half-quartern loaves consumed in the metropolis in the year, and we shall find they form a pyramid which measures two hundred square feet at its base, and extends into the air to a height of one thousand two hundred and ninety-three feet, or nearly three times that of St. Paul's.

Turning now toward the sound of rushing waters, we find that the seven companies are filling the mains for the day. If they were allowed to flow into the area of the adjacent St. James's Park, they would in the course of the twenty-four hours flood its entire space with a depth of thirty inches of water, and the whole annual supply would be quite sufficient to submerge the city part of London (one mile square) ninety feet.

Of the fish we confess we are able to say nothing: when numbers amount to billions, the calculations become too trying to our patience. We have little doubt, however, that they would be quite sufficient to make the Serpentine one solid mass.

Of ham and bacon, again, preserved meats, and all the countless comestibles, we have taken no account; and, in truth, they are little more to the great mass than the ducks and geese were to Sancho Panza's celebrated mess—"the skimmings of the pot."

The railways having poured this enormous amount of food into the metropolis, as the main arteries feed the human body, it is distributed by the various dealers into every quarter of the town; first into the wholesale markets, or great centres; then into the sub-centres, or retail shops; and lastly into the moving centres, or barrows of the hawkers: by which means nourishment is poured into every corner of the town, and the community at large is supplied as effectually as are the countless tissues of the human body by the infinitely divided net-work of capillary vessels. These food distributors amount to about 100,000. Among them are no less than 7000 grocers, nearly 10,000 bakers, and 7000 butchers. DR. WYNTER.

THE DESERTED VILLAGE.

[OLIVER GOLDSMITH was born at Pallas, in the county of Longford, in 1723, and died in 1774. He was the son of an Irish curate, and was educated at Dublin, Edinburgh, and Leyden, with a view to the medical profession. But his eccentricities and careless conduct were the prolific source of difficulties to himself and friends. Goldsmith is a very extensive writer, being at once a poet, an essayist, a dramatist, and a historian. His two principal poems, "The Traveller" and The Deserted Village," belong to the highest class of descriptive poetry, and the latter is certainly the most finished of all his productions.]

SWEET Aúburn ! lòveliest village of the pláin,
Where heàlth and plénty| chéered the labouring swàin;
Where smíling sprìng| its eàrliest visits páid,
And parting sùmmer's lingering blóoms| delàyed;
Déar lòvely bowers of innocence and eáse,
Seats of my yoúth, when èvery sport could please !
How òften| have I loitered o'er thy gréen,
Where humble háppiness| endéared each scène;
How òften| have I páused on every chàrm—
The sheltered cót, the cultivated fàrm,
The never-failing broòk, the busy míll,
The decent chúrch| that tópped the neighbouring hìll,
The hàwthorn-bush, with seats beneath the sháde,
For talking áge| and whispering lòvers made !
How òften| have I blessed the coming dáy,
When toil remítting| lent its turn to plày,

And all the village tràin, from labour frée,
Led up their spórts| beneath the spreading trèe;
While màny a pastime| circled in the sháde,
The yoùng conténding| as the óld survèyed;
And màny a gambol| frolicked o'er the groúnd,
And sleights of árt| and feats of strèngth went round;
And still, as each repeated pleasure tíred,
Succéeding sports| the mirthful bánd inspìred.
Swèet| was the soúnd, when oft, at evening's clóse,
Up yonder híll| the village mùrmur| rose;
Thére, as I passed with careless steps and slów,
The mingling nótes| came sóftened from belòw:
The swáin, respònsive| as the mìlkmaid| súng;
The sober hérd, that lówed to meet their yoùng;
The nóisy gèese, that gàbbled o'er the póol;
The plàyful chíldren| just let loóse from schoòl;
The watch-dog's voice, that bayed the whispering wínd;
And the loud láugh, that spóke the vacant mìnd.
Thése àll, in sweet confusion, sought the sháde,
And filled each páuse| the nìghtingale had made.

* * * * * *

Thése| were thy chàrms, sweet village ! sports like thése,
With sweet succéssion, taught even tòil to please;
Thése| round thy bòwers| their cheerful influence shéd,
Thése| *wère* thy charms—but all these chárms| are flèd.

GOLDSMITH.

THE POWER OF PRAYER.

CHILD of Gód ! pray òn. By práyer| thy hànd can touch the stárs, thy árm| stretch up to heàven. Nor let thy holy boldness be dàshed by the thóught| that prayer has no power to bend these skìes, and bring down thy Gód. When I pull on the rope which fastens my frail and little boat| to a distant and mighty shíp, my poor strength may not draw its vast bulk to mé, but I draw myself to ìt—to ride in safety|

under the protection of its gúns, and enjoy in wánt| the fulness of its stòres. And it èqually serves my purpose, and supplies my néeds, that práyer, although it were powerless to move Gòd to mé, moves mé to Gòd. If Hè does not descend to eárth, I| ascend to heàven.

Child of Gód! pray òn. Were it indispènsable for thy sáfety| that Gòd should rend these heávens, it shòuld be done —a wondering wórld| should seè it done. I dare believe *thát;* and "I am nòt mad, most noble Festus." Have not these heavens been alréady rent? Eighteen hundred yeàrs ago, robed in humánity, God himsèlf came down. Thèse blue skíes, where only làrks now sing and eagles saíl, were cleft with the wíngs, and filled with the sóngs of his angel tràin. Among the àncient orbs of that fírmament, a strànger star appeared, travelling the heávens| and blàzing on the banner borne before the Kíng, as he descènded on this dárk and dístant wòrld. On Cànaan's dewy ground, his lowly béd, the eye of mórning| saw the shàpe and fórm of the Son of Gòd; and dusty roàds, and winter snòws, and desert sànds, and the shóres and very wàves of Galilee, were imprèssed with the fóotprints of the Creàtor. By this mànger, where the kingly babe lies crádled—beside this cròss, upon whose ignominious arms the glory of the universe is húng—by this silent sèpulchre, whére, wrăpped in blōody shrōud, the body reposes on its bed of spíces, and while Roman sentinels walk their moonlit róund, Deàth, a bound càptive, sits withín, so soon as the sleeper wákes, to be disàrmed, uncròwned, and in hìmself have death pút to death—faith can beliève all that God has revéaled, and hópe for all that He has pròmised. Reading on that mànger, on that cròss, deèply lettered on that rocky sepùlchre, these glorious wórds—"Hé that spared not his own Sòn, but delivered him up for us áll, how shall hè not with hím also freely give us àll things?"—Faith lifts an eagle eye to heáven, and rising to the boldest flíghts, soars alóft| on the wings of pràyer.

DR. GUTHRIE.

THE GLORY OF GOD IN CREATION.

(Psalm lxxiv. 16, 17.)

[Thomas Moore, the modern poetical glory of Ireland, was born in Dublin, in 1780. His largest works are "Lalla Rookh" and "The Loves of the Angels;" but his lyrics, entitled "The Irish Melodies," are the most popular of his poetic efforts. His poetry abounds in highly fanciful imagery and patriotic appeals. Mr. Moore is also the author of biographies of Sheridan and of Byron, and of the Eastern romance "The Epicurean."]

Thōu ārt, O Gōd! the life and líght|
  Of all this wondrous wórld we seè;
Its glow by dày, its smile by níght,
  Are but refléctions| caught from Thèe:
Wherè'er we turn, Thy glories shíne,
And all things fair and bríght| are Thìne.

When Dāy, with fārewell beām, delays|
  Among the opening clouds of Even,
And we can almost think| we gaze
  Through golden vistas into Heáven—
Those hues| that mark the sun's declíne,
So sòft, so rádiant, Lord! are Thìne.

When Night, with wings of starry gloom,
  O'ershadows all the earth and skíes,
Like some dark| beauteous bird, whose plume|
  Is sparkling with a thousand eyés—
That sacred gloòm, those fires divíne,
So grànd, so coúntless, Lord! are Thìne.

When yòuthful Spring| around us breáthes,
  Thy spirit| warms hèr fragrant sìgh,
And every flòwer| the Summer wreáthes,
  Is born| beneath that kindling eỳe:
Wherè'er we turn, Thy glories shìne,
And all things bright and fair| are Thìne!

Moore.

THE DYING CHRISTIAN TO HIS SOUL.

[ALEXANDER POPE was the son of a linen draper in London, where he was born in 1688. He died in 1744. Pope gives the key-note to the "Augustan Age" of English literature, and stands unrivalled in polished verse on moral subjects. At the early age of twelve, he became the sole director of his own studies, and about the same period, he published his "Ode on Solitude," the first fruits of his poetic genius. Besides being a most voluminous writer, he also published a translation of the Iliad and Odyssey of Homer; the former of which brought him £5000, which he laid out in the purchase of a villa at Twickenham, whither he removed in 1715.]

Vītal spārk of hēavēnly fláme!
Quít, oh, quít this mortal fràme;
Trémbling, hòping, lìngering, flýing,—
Oh, the páin! the blìss of dying!
Ceàse, fond nature, ceàse thy strífe,
And let me lànguish into life.

Hàrk! they whìsper; angèls sáy,
Sister spírit, come awày;
What is thís! absorbs me quìte,
Steals my sénses, shuts my sìght,
Drowns my spírits, draws my breàth?
Tèll me, soul, can thìs be déath?

The world! recèdes: it disappèars:
Heàven! opens on my éyes! my eárs
With sounds seràphic! ring.
Lénd, lend your wìngs! I móunt, I flỳ!
O Gráve! whère is thy víctory?
O Deáth! whère is thy stíng?

POPE.

COMPOUNDS OF THE LIGHT METALS.

Alabaster, (*alabastron*, G.)
Alum, (*alumen*, L.) a well-known salt. Hence *alumina* and *aluminum*.
Calcium, (*calx*, L.) Hence also *calcareous*, containing lime, or having the qualities of lime.
Chlorine, (*chloros*, G.)
Indurated, (*in*, *durus*, L.) made hard.
Mica, (*mico*, L.)
Porphyry, (*porphyra*, G.)
Selenite, (*selene*, G.) *Lit.* moon-like.
Silicate, a salt containing silica.
Sodium, (*soda*.
Stalactite, and
Stalagmite, (*stalactos*, *stalazo*, G.)
Sulphuric acid, (*sulphur*, L.) an acid formed by sulphur and oxygen. Hence *sulphate*, a salt containing *sulphuric acid*.

COMMON SALT.

Nearly fifty of the simple substances, or elements, of which all matter is composed, are regarded as metals. But of these a considerable number can scarcely be said to exist separately. They are found only in combination, and, though the chemist can separate them, they are of little importance in their simple or metallic state. Some of their compounds, however, are very abundant, and claim our first notice.

Common or *culinary* salt is one of these compounds. Few better examples could be given of a substance differing entirely from both the elements of which it is composed. There is first a gas, noxious and suffocating, producing violent cough and irritation when inhaled even in exceedingly small quantity. It is one of the non-metallic elements, and, from its greenish-yellow colour, receives the name of *chlorine*. And what companionship, so to speak, deprives this substance of its colour, collects its particles into the form of a solid, cures it of its deadly properties, and converts it into a healthy and agreeable condiment? That of a metal called *sodium*, somewhat lighter than water, in which, when warm, it actually takes fire and burns! With the metal itself we are not much acquainted, but its oxide, *soda*, is a well-known substance.

Such, then, are the ingredients of the only mineral (unless we call water a mineral) which forms a part of our daily food. Its great reservoir is the ocean, in which Providence has given us a supply that may well be regarded as inexhaustible. Some writers say there is enough to cover all Europe to the depth of two or three miles. It may be obtained in any quantity, mixed with a little of some other salts, by simple evaporation of the water in which it is dissolved.

But immense quantities of this substance are also found in a solid form. In a few desert regions, it covers the ground like hoar-frost for hundreds of miles together. Some hills of considerable size are entirely composed of it; one at

Cardona, in Spain, is 400 feet high, and about three miles in circumference. Still greater stores lie embedded deep in the bosom of the earth. Salt mines of great extent are worked in Cheshire, and at several places in continental Europe. The largest and most celebrated are at Wieliczka, in Austrian Poland. There, at a depth of seven or eight hundred feet below the surface of the earth, vast caverns have been excavated, extending over an area of several hundreds of acres. Huge pillars of salt are left to support the roof, and long, lofty passages lead from cavern to cavern, as if they were the chambers of a subterranean palace. The air is dry and salubrious. Many horses live for years in the interior of the mines, in stables hewn for them out of the solid salt, which has the curious effect of rendering them totally blind. At the bottom are several lakes, navigable by boats; and there is even said to be, in one place, a spring of good *fresh* water. But perhaps the greatest curiosity of all is a chapel dedicated to St. Anthony. Its walls, its roof, and the columns that support it, are all sculptured in salt; so also is its furniture, including the altar, the candelabra, and other ornaments, the pulpit, the crucifix, and the statues of the virgin and patron saint. These mines naturally attract many visitors, and are really a splendid sight. The vast extent and height of the excavations, and the brilliancy of the walls and pillars, especially when illuminated by torchlight, have a grand and imposing effect.

The salt obtained from mines is called rock salt. When too impure for use, it is dissolved in water, from which it is again separated, sometimes in a crystallized form, by means of evaporation. Its crystals are cubes; they are seen in the coarse-grained variety used in curing provisions.

Many little trinkets are made of rock salt, but though beautiful, they are not of much value. It can scarcely be necessary to mention the important purposes to which this substance is usually applied.

LIME.

Another metallic element, difficult to procure, and still more difficult to retain, in its separate state, is *calcium*, whose oxide is the well-known substance *lime*. Even the oxide does not occur in nature, except in combination. Its salts, however, are extremely important, especially the *carbonate*, formed by its union with *carbonic acid*.

No single substance appears in so many different forms as *carbonate of lime*, or, as it is sometimes called, *calcareous spar*. Many a mountainous district owes its grandeur to huge masses of limestone rock, piled one above another in the most picturesque variety. The cavities of the darkest and most rugged of these rocks are lined with white and more or less transparent crystals, whose brilliancy and polish the lapidary's art may imitate, but cannot surpass. Strange as it may seem, the rocks and the crystals they enclose are one and the same substance, composed of the same elements, in exactly the same proportion. They consist of carbonate of lime, sometimes, it is true, mixed with very small quantities of other substances.

Limestone rocks, moreover, contain vast caverns, where the same materials assume, under the fashioning hand of nature, the appearance of a new substance. As water percolates through the rocks above, it carries with it small particles of the calcareous matter of which they are composed. Collecting in drops on the roof of the cavern, it deposits there a thin film of stony sediment, and then, falling to the floor, it gradually evaporates, and leaves a sediment there also. Every successive drop brings a fresh deposit, until huge pillars are formed, those rising from the floor being called *stalagmites*, while those which increase from the roof downwards, like great icicles, receive the name of *stalactites*. Sometimes the two formations meet, and form solid columns from top to bottom of the cavern. These, continually varying in size and appearance, as fresh matter is deposited upon them, eventually fill up the whole cavern, and convert it into a deposit of *alabaster*.

This, then, is another variety of the same carbonate of lime.

It also occurs in the form of *marble*, of various qualities; and the *chalk* of the English Downs is entirely composed of it. In the deep sea, the coral builds with it his tiny palace; and the little shellfish forms it into pearls, worthy to adorn the diadem of kings.

These are some of the various forms assumed by this wonderful substance, but the list is by no means exhausted. Of its uses it is almost needless to speak. What should our builders do without marble and limestone? The former is employed in the construction of our finest edifices, and the latter, besides its use as a stone for plainer buildings, furnishes the cement by which all mason-work is kept together and consolidated. Lime for agricultural purposes is derived from the same source. Chalk is used in gilding and several other arts; coral and pearls are esteemed as ornaments; and, finally, marble is the favourite material of the sculptor, in which have been enshrined many of the highest triumphs of artistic genius.

Lime unites with *sulphuric acid* to form another important salt, called *sulphate of lime*, or *gypsum*. Of this substance is composed the well-known *plaster of Paris*, so named from its being extracted in large quantities at Montmartre, near that capital. It is extensively employed for the purpose of making casts of statues and other objects, thus enabling us, at a trifling expense, to multiply faithful copies of the admirable works of ancient sculpture. It is also used for moulds in the porcelain and earthenware manufactures. When crystallized, it is perfectly transparent, and capable of being split into very thin plates, which sometimes served, in ancient times, the purposes of glass. In this state, it is called *selenite*. A finer quality of the same substance, remarkable for its purity and whiteness, has received the name of *alabaster*. It is chiefly found in Tuscany, where it is manufactured into graceful vases, and other articles of taste. Thus we have two kinds of alabaster, differing in appearance as well as in composition; the

calcareous variety formerly mentioned being rarely white, but generally veined and clouded with other colours. The value attached to these substances in ancient times is well illustrated by the interesting occurrence recorded in Matth. xxvi. 6-13.

ALUMINA.

Some of the rarest and most beautiful productions of the mineral kingdom, as well as others less dazzling, but more useful, are wholly or partly composed of *alumina*. This substance is the oxide of a bluish white metal called *aluminum*, which can be wrought with the same ease as silver, and is extensively used by the jeweller and silversmith in the production of ornaments for dress. The name is derived from *alum*, a well-known salt, of which alumina forms an essential ingredient; but it is also found in other compounds of still greater importance. In a former lesson it was stated that a very large proportion of all our rocks and stones are compounds of silica; it has now to be added, that alumina is one of the substances with which that silica is most frequently combined.

On examining a piece of *granite*, it will be found that it is composed, as its name indeed implies, of grains or coarse particles of at least three different kinds of stony substance. One of these, the hardest of all, is quartz, which consists of silica alone. The others, *mica* and *felspar*, contain large quantities of alumina. The glittering particles in the granite are mica, and the great mass of the stone is usually felspar.

Felspar is, in fact, one of the most abundant substances in nature. Gneiss, porphyry, and some other rocks, are, like granite, chiefly composed of it. It is found of almost every colour, and is often beautifully crystallized. Some of its numerous varieties are even valued as ornamental stones. But, strange to say, it becomes most interesting when it is decomposed, and passes into the form of *kaolin*, or *porcelain clay*, a pure *silicate* of alumina. This change, the causes of

which are not very well understood, is seen in great perfection in certain districts of Devonshire and Cornwall; the felspar of the fine white granite of these localities being often disintegrated to an extraordinary depth, and the rock altered to a substance resembling soft mortar. This mortar consists of a pure white clay, mixed with the quartz and mica of the granite, from which it is separated by washing. The water impregnated with it is collected in tanks, and gradually deposits the clay, which is then carefully dried, mixed with finely powdered quartz or flint, and manufactured into porcelain, or chinaware. This manufacture was long confined to China, but is now carried on in our own country, and in several other parts of Europe. We need not wonder that it is a somewhat difficult art, and requires great care and skill, when we consider that it converts an opaque, earthy substance into translucent vases of the most elegant forms, decorated with paintings as brilliant as they are durable. Some of the finest specimens of porcelain have been sold for hundreds of pounds.

But, if kaolin is the purest, it would scarcely be safe to say that it is in every sense the most valuable or important of the *clays*. Most of these, however, are merely varieties of kaolin mixed with sand of quartz, limestone, or other substances. One of the most useful kinds is *potter's clay*. It is employed in the manufacture of bricks, roof and drain tiles, chimney-cans, flower-pots, brown earthenware vessels for domestic purposes, and many other articles. The colours of this substance, which usually becomes red in the fire, are due to small quantities of iron contained in it. Those clays, however, which owe their colours to other principles, sometimes burn white. *Loam* contains more sand than potter's clay. It is invaluable as an ingredient of the soil, to which it gives cohesiveness, enabling it to retain the necessary moisture, and preventing it from being too easily removed from the roots of plants by wind and rain.

When clay becomes *indurated*, or turned by some unknown process into stone, it forms *clay-slate*. This stone is applied to many different purposes, as it may be obtained, with

comparative ease, in slabs of almost any size and thickness required. It is the best material for roofing houses, and is also extensively used for pavement. Slates for writing on are made of it, and a softer variety, called *shale*, is cut into slate-pencils. Large slate-quarries are worked in Argyleshire, and those of Carnarvonshire, in Wales, are still more extensive.

It would be an endless task to enumerate all the compounds of alumina. But it is worthy of remark, that this soft, unctuous substance, the basis of clay, enters into the composition of nearly all the more valuable gems. Topaz, emerald, and aquamarine are chiefly composed of silica and alumina, the same materials which form clay. But still further, the oriental gems, usually known as sapphires and rubies, may be said to consist of alumina alone. They are the hardest and most precious stones after the diamond. Sometimes they are colourless; sometimes red, blue, yellow, or green; and sometimes the same specimen exhibits two or three different colours. All these varieties are formed of the same substance, which is called *corundum*, a name imported with it from the East; it consists of crystallized alumina, usually coloured by a little of some other metallic oxide. *Emery*, used for polishing glass and metals, is a coarse variety of corundum.

It cannot fail to excite our admiration, that the materials we daily use and look upon as common, are sometimes fashioned by infinite wisdom into these splendid forms. The pencils with which we write on paper were already said to be almost identical in composition with the diamond; and when instead of paper we use slates, both slates and pencils claim kindred with the topaz, the emerald, and the sapphire!

QUESTIONS FOR EXAMINATION.

How many metallic elements are there? What are the ingredients of common salt? Where is it chiefly found in solution? Where solid? Where have we salt mines in England? Describe those of Wieliczka. What is rock salt? When impure, how is it purified? What are the constituents of lime? Which of its salts is most important? Mention some of the forms in which carbonate of lime occurs. Describe the process by which calcareous *alabaster* is formed. What is the composition of the other kind of alabaster? How do they differ in

appearance? What are *stalagmites? stalactites?* For what purposes do we use limestone? chalk? marble? pearls? plaster of Paris? What is selenite? Explain the composition of granite. What is felspar composed of? mica? quartz? From what is porcelain clay formed, and what is its composition? How do other clays differ from it? Name some of them. For what purposes are they useful? What is slate? shale? Which gems are composed almost entirely of alumina? Which of silica and alumina?

ON THE THREATENED INVASION (1803).

[ROBERT HALL, a celebrated Baptist preacher and a distinguished theological writer, was born at Arnsby in Leicestershire, in 1764, and died at Bristol in 1831. Mr. Hall was gifted with a powerful and persuasive eloquence; but it was his "Sermon on Modern Infidelity," that established his fame as a divine. His works have been collected and published since his death, in six vols. 8vo.]

BY a series of criminal énterprises, the liberties of Eúrope| have been gradually extìnguished; and wè| are the only people in the eastern hémisphere| who are in possession of equal láws| and a free constitùtion. But fréedom, driven from every spot on the cóntinent, is pursued even hère, and thréatened with destrùction. The inundation of lawless power, after covering the whole éarth, threatens to follow us hère; and wé are most exàctly, most crìtically, placed in the only aperture| where it can be successfully repélled—in the Thermópylæ of the wòrld. As far as the interests of freédom| are concerned—the most important by far of sub'lunary interests—yóu, my countrymen, stand in the capacity| of the federal representatives of the human ràce; for with yòu it is to determine| (under God) in what condítion| the latest posterity shall be bòrn. If líberty, after being extinguished on the Còntinent, is suffered to expire hére, whènce is it ever to emérge| in the midst of that thick níght| that will invèst it? It remáins with yòu, then, to decíde, whether that fréedom, at whōse voīce the kingdoms of Eūrope| awōke from the sleēp of āges, to run a cāreer of virtūous emūlation| in everything great and góod—the fréedom| which dispelled the mists of superstítion, and invited the nations to behold their Gòd, whose magic tórch| kindled the rays of gènius, the enthusiasm of pòetry, and the flame of éloquence—the fréedom| which poured into our lap| ópulence and àrts, and embellished life| with

innumerable institutions and impróvements, till it became a theatre of wónders—it is for yòu to decide, whether this freedom| shall yet survíve, or be covered with a funeral-páll, and wrapped in eternal glòom. It is not necessary| to await your determinàtion. In the solicitude you feel| to approve yourselves worthy of such a trúst, every thought of what is afflicting in wàrfare, every apprehension of dánger| must vànish, and you are impàtient to mingle in the báttle of the civilized wòrld. Gò then, ye defenders of your coúntry, accompanied with every auspicious ómen; advánce with alàcrity into the fiéld, where God himsèlf| musters the host to war. Religion| is toò much interested in your súccess| not to lend you her àid; she will shed over this énterprise| her selèctest influence. While yòu are engaged in the fiéld, mány will repair to the clòset, mány| to the sànctuary; the faithful of every náme| will employ that práyer| which has power with Gòd; the feèble hands, which are unequal to any óther weapon, will grasp the sword of the Spìrit; and from mỳriads of humble| contrite heárts| the voice of intercèssion, supplicàtion, and wéeping, will mingle| in its ascent to heáven, with the shouts of báttle| and the shock of àrms. And it is next to impòssible for víctory not to cròwn your exertions; for the extènt of your resóurces, under God, is equal to the jústice of your caùse. But should Providence| determine ótherwise — should you fáll in the struggle, should the nátion fall—you will have the satisfaction (the purest allotted to man!) of having performed your pàrt; your names will be enrolled| with the most illustrious deàd; while postèrity to the end of títme, as often as they revòlve the events of this period (and they will incéssantly revolve them) will turn to yóu a reverential eỳe, while they mourn over the freédom| which is entombed in yòur sèpulchre. I cannot but imágine| that the virtuous hèroes, lègislators, and pátriots of every age and coúntry, are bènding from their elevated séats| to witness this contest, as if they were incapable, till it be brought to a favourable íssue, of enjóying their eternal repòse. Enjòy that repose| illustrious immortals! Your màntle féll| when you

ascènded; and thoùsands| inflámed with your spìrit, and impatient to tread in your stéps, are ready to swear by Hím| thāt sĭtteth upon thē throne, and lĭvēth for ĕver and ĕver, they will protect freédom in her last asy̆lum, and nèver desert that cáuse, which you sustaìned by your lábours, and ceménted with your bloòd.

ROBERT HALL.

THE ARCTIC EXPEDITION.

[FOR more than three hundred centuries it had been the ambition of brave and skilful navigators to immortalize their names by the discovery of a North-west passage through the Arctic Seas to the golden realms of the East. Previous to 1845, more than one hundred and twenty expeditions had successively sailed to the Northern seas in order to discover that mysterious passage, but had all failed in their object.

In the spring of 1845, the *Erebus* and *Terror* with a gallant crew under the command of Sir John Franklin sailed to the far north. Sir John Franklin resolved once more to renew his efforts to solve the great problem of a North-west passage. For three years nothing was heard of this gallant expedition and its leader. The Government sent out expedition after expedition in search of the gallant hero and his crews without any very satisfactory result. Then Lady Franklin, finding the Government unwilling to renew the search, with a devotion that no disappointment could damp, fitted out the *Fox* and despatched the expedition which, under the command of Captain M'Clintock, proved so successful. Franklin had discovered the North-west passage in 1847, and died on the 11th of June that same year, on board his ship.]

BY the pale beams of the aurora darting across the dark sky, a little vessel is seen wedged in the ice. Her decks being roofed over and covered with snow, she is scarcely to be recognized in the icy waste around. Arrested by the conglomerated floes, her brave crew have bidden farewell to the sun, but not farewell to hope, and not farewell to the chivalrous enterprise on which they have gone forth. Here they wait till Spring, with smiling face, dancing over the dreary region, shall break up their prison by her magic tread, and bid them go free; then, undeterred by past dangers, from that vantage-ground they will pursue their search. But no! while apparently stationary, every surrounding object retaining its relative position, the whole icy plain is drifting southwards. Old Winter, indignant at their intrusion so near his ancient throne, hurls them back

thirteen hundred miles. Then the ice breaking up with a thousand thunders into huge masses, like so many Titanic war-gallies, charges down upon the groaning barque, which, gallantly fronting the onset, cuts her way through the foe. Escape from impending destruction is the signal for encountering fresh perils. Again that little vessel penetrates the empire of ice—and again its stern monarch clasps her in his cold embrace, chains her to his glittering throne, and draws around her the dark curtain which no rising sun for many weeks shall pierce.

What is the object of her brave crew? They hope that the blessing of those that are "ready to perish" may fall upon them, and that "the widow's heart may sing for joy." Yet how slight their encouragement! Expedition after expedition has failed to discover any trace of Franklin and his brave companions. Twelve years have elapsed. Still another attempt is made. The little vessel "Fox" is fitted out. M'Clintock, in the true spirit of a British sailor, allured rather than repelled by hardship and danger, at woman's* call in the cause of philanthropy, undertakes the command. Volunteers, in embarrassing numbers, ask to serve in any capacity. They are now (1858) spending their second winter in journeys over the ice, with a temperature seventy degrees below freezing. At length they discover relics of the long-lost voyagers, some of whom may still survive in the huts of the Esquimaux. Alas, they find a record of disaster. Then a bleached skeleton. A native reported that Franklin's party "fell down and died as they walked along." And now they come to a boat. In it are two other skeletons—also precious relics, a watch, a fragment of slipper worked by loving fingers, a Bible with texts interlined. The problem is solved. They are too late to receive the blessing of men ready to perish—too late to make the widow's heart sing for joy.

Yet their heroism was not wasted. Nothing kindly, bravely done, ever is. The doer at least is bettered. Valuable discoveries were made, agonizing suspense was

* Lady Franklin.

ended, fresh testimony was afforded of the value set on human life, additional pledges were given that no Englishman imperilled in the discharge of duty will be abandoned, the moral nature of those heroic seekers was raised, and their work of charity was looked on with approbation from above!

NEWMAN HALL.

SIR JOHN FRANKLIN.

THE Polar clouds uplift—a moment and no more,
And through the snowy drift we see them on the shore,
A band of gallant hearts, well-ordered, calm, and brave,
Braced for their closing parts,—their long march to the grave.

Through the snow's dazzling blink, into the dark they've gone:—
No pause: the weaker sink, the strong can but strive on,
Till all the dreary way is dotted with their dead,
And the shy foxes play about each sleeping head.

Unharmed the wild deer run, to graze along the strand,
Nor dread the loaded gun beside each sleeping hand.
The remnant that survive onward like drunkards reel,
Scarce wotting if alive, but for the pangs they feel.

The river of their hope at length is drawing nigh—
Their snow-blind way they grope, and reach its banks to die!
Thank God, brave Franklin's place was empty in that band!
He closed his well-run race not on the iron strand.

Not under snow-clouds white, by cutting frost-wind driven,
Did his true spirit fight its shuddering way to heaven;
But warm, aboard his ship, with comfort at his side
And hope upon his lip, the gallant Franklin died.

His heart ne'er ached to see his much-loved sailors ta'en;
His sailors' pangs were free from their loved captain's pain.
But though in death apart, they are together now—
Calm each enduring heart,—bright each devoted brow!

PUNCH.

"YOU WILL REPENT IT."

A YOUNG ófficer| had sò far forgotten himself, in a moment of irritátion, as to strike a private sóldier, full of personal dìgnity (as sometimes happens in àll ranks), and distinguished for his còurage. The inexorable laws of military díscipline| forbade to the injured sóldier| any pràctical redress. He could look for no retaliátion by àcts. Wòrds only| were at his command; and, in a tumult of indignátion, as he turned away, the soldier said to his ófficer| that he would "make him repènt it." This, wearing the shape of a ménace, naturally rekìndled the officer's anger, and intercèpted any disposition which might be rising withín him| towards a sentiment of remòrse; and thus the irritation between the two young mén| grew hótter than befòre.

Some wéeks after this| a partial áction took place with the ènemy. Suppóse yourself a spectàtor, and looking down into a válley occupied by two àrmies. They are fácing each other, you see, in martial arrày. But it is no móre than a skìrmish which is going on; in the cóurse of which, however, an occasion suddenly arises| for a desperate sèrvice. A redoùbt, which has fallen into the enemy's hánds, must be recaptured at àny price, and under círcumstances| of áll but hopeless dìfficulty. A strong párty| has volunteered for the sèrvice; there is a crý for somebody to heàd them; you see a soldier step out from the ránks| to assume this dangerous leàdership; the párty| moves rapidly fòrward; in a few mínutes| it is swallowed up from your eyes in clouds of smòke; for óne hàlf-hour from behínd these clouds| you receive hieroglyphic reports of bloody strìfe—fierce repeating signals, flashes from the gùns, rolling mùsketry, and

exulting hurráhs, advàncing or recéding, sláckening or redoùbling.

At léngth| áll is òver; the redóubt has been recòvered; that which was lóst| is foùnd again; the jewel which had been made cáptive| is ransomed with bloòd. Crimsoned with glorious góre, the wreck of the conquering party is reliéved, and at líberty to retùrn. From the ríver| you see it ascènding. The plume-crested officer in commánd| rushes fòrward, with his lèft hand raising his hát| in homage to the blackened frágments of what ònce was a flag; whilst with his ríght hand he seizes that of the léader, though no more than a private from the rànks. *Thát* perplexes you not: mystery you see none in *thàt.* For distinctions of órder perìsh, ránks are confoùnded, "hìgh and lów" are words without a meàning, and to wrèck goes every notion or féeling| that divides the noble from the nóble, or the bráve man from the bràve. But whèrefore is it that now, when suddenly they wheel into mutual recognítion, suddenly they paùse? This sòldier, this ófficer—who arè they? O, reáder! ónce befòre they had stood face to face—the sòldier it is that was strúck; the ófficer it is that strùck him. Once agàin they are meeting; and the gaze of ármies| is upòn them. If for a mòment| a doubt divídes them, in a móment| the doubt has pèrished. One glànce exchanged betwéen them| publishes the forgíveness| that is sealed for èver. As one who recovers a brother whom he had accounted déad, the officer sprang fòrward, threw his arms around the neck of the sóldier and kìssed him, as if he were some màrtyr| glorified by that shadow of déath| from which he was retùrning; whilst on *his* part, the sòldier, stepping back, and carrying his open hand through the beautiful motions of the military salute to a supérior, makes this immortal ànswer—thát answer| which shut up for ever the memory of the indignity óffered to him, even whilst for the làst time allúding to it:—"Sìr," he said, "I told you befòre| that I would *make you repent it.*"

DE QUINCEY.

THE HEAVY METALS.

Alloy, (*allier*, F.; *ad*, *ligo*, L.)
Amalgam, (*malagma*, *malasso*, G.) Hence *amalgamate*, *amalgamation*.
Barometer, (*baros*, *metron*, G.) an instrument for ascertaining the weight of the air; a weather-glass.
Carbonaceous, containing *carbon*.
Conical, having the shape of a *cone*.
Ductile, (*duco*, L.) that may be drawn out into wire.
Elastic, (*elauno*, G.) springy; having the power of recovering its form and dimensions after pressure.
Flexible, (*flecto*, L.) that may be bent without breaking.
Fusible, (*fundo*, L.) that may be melted.
Hæmatite, (*haima*, G.) blood-stone.
Lava, a melted substance thrown out by volcanoes.
Loadstone, (*lead*) *Lit.* the stone that *leads* or *draws*.
Magnetic, of the nature of a *magnet* or *loadstone*.
Malleable, (*malleus*, L.) that may be hammered or pressed out into thin plates.
Meteoric, (*meteoros*, G.)
Pyrites, (*pyr*, G.)
Sonorous, (*sono*, L.) giving sound when struck.
Spathose, (*spath*, German for *spar*) sparry.
Specular, (*speculum*, L.) having a mirror-like surface.
Sulphuret, a compound with *sulphur*.
Thermometer, (*thermos*, *metron*, G.) an instrument for ascertaining the temperature of anything.

PLATINUM, GOLD, MERCURY.

From the metallic bases of soda, lime, and alumina, and a few others of like character, *the metals proper* are distinguished by their great weight, in which they surpass all other substances. Some of them are found in a pure, or (as it is usually called) *native* state; but a much greater number have to be separated, by artificial means, from compounds called *ores*. These ores always contain one or more non-metallic elements. When two metals combine together, the result is not called an ore, but an *alloy*, unless one of them is mercury, in which case it is called an *amalgam*.

The most important metals are platinum, gold, mercury, silver, copper, tin, lead, and iron.

Platinum is chiefly procured from the Ural mountains and from South America. It is the heaviest substance known, weighing more than twenty times its own bulk of water. But it is chiefly remarkable for its refractory and unalterable nature, even when exposed to intense heat, or to the action of those acids by which most other metals are dissolved. It is capable of taking a good polish, and is not liable to rust or tarnish. These qualities render it extremely useful in the construction of many philosophical instruments, such as crucibles, mirrors for telescopes, measuring rods, pendulums, watch wheels, and the like.

Gold has been known from the earliest times. The mummies of Egypt are adorned with it, and medals of it still exist, which are of very high antiquity. Not long ago, our supplies were mostly derived from Siberia, the west coast of Africa, Peru, and Brazil; but the gold-fields of those districts have been completely thrown into the shade by the announcement of successive discoveries in California, Australia, New Zealand, and British Columbia. From these places most of our gold is now obtained. It occurs native, or alloyed with silver, and sometimes also with small quantities of copper and iron, either in veins traversing quartz and similar rocks, or in beds of sand and other alluvial substances that have been washed down by rivers. Its beautiful colour, and the splendid polish it is capable of receiving, have caused it to be largely employed for decorative purposes. Objects of pure gold, however, would not only be too expensive, but too soft to retain their shape; and hence, in Europe at least, it is usually alloyed with copper or some other metal. Fortunately for luxury, the extreme malleability of gold enables us to cover with it all sorts of substances, which thus acquire, externally, the same brilliancy as the metal itself. The gold leaf used for this purpose is said to be, in some cases, a thousand times thinner than paper. Gold is also the most ductile of the metals; one ounce of it may be drawn out into a wire several miles long; and the same quantity is sufficient to gild a silver wire whose length would be measured by hundreds of miles.

Gold is well known to be the symbol of wealth, and the standard of value for other substances. For coinage it is admirably adapted; it has a high intrinsic value, increased by its scarcity; it is also very durable, capable of exact subdivision, and easily distinguished from other substances. The sterling gold, of which sovereigns are made, contains twenty-two parts of pure metal to two of alloy.

Mercury, or *Quicksilver*, is remarkable as the only metal which remains fluid at the ordinary temperature of the atmosphere. In this, its usual state, it has the brilliant

whiteness of silver, and, when pure, neither rusts nor tarnishes by exposure. It is very heavy, has neither taste nor smell, and feels particularly cold. The most important ore of mercury is *cinnabar*, a compound of the metal with sulphur. It is found in several localities, of which the most celebrated are Almaden in Spain, and Idria in the south of Austria. Quite recently it has been discovered in great abundance, and of remarkable purity, in California.

The uses of mercury are many and important. *Calomel*, one of its compounds, is a valuable medicine; another, *corrosive sublimate*, containing exactly the same elements in a different proportion, is a deadly poison. Mercury is also an ingredient of the beautiful pigment called *vermilion*, and forms with tin an amalgam used for silvering the backs of looking glasses. Every one has seen the little tube of mercury in the barometer and thermometer, the construction of which will be afterwards described. But perhaps the most important application of this metal is that by which silver and gold are separated from their ores.

SILVER, COPPER, TIN, LEAD.

Silver is so well known as hardly to need description. When pure, it is white and brilliant, but it becomes tarnished by exposure to the air. It is very malleable, flexible, and ductile. Native silver is sometimes found in grains, and sometimes in larger masses, but it is from ores that our supplies of this valuable metal are chiefly obtained. Of these ores, the most important are *sulphurets*, or compounds of the metal with sulphur. They often contain other metals besides silver. *Galena*, for example, though considerable quantities of silver are sometimes extracted from it, is properly an ore of lead. Among the principal silver mines may be mentioned those of Mexico and Peru, of the Hartz mountains in Germany, and of Kongsberg in Norway.

A curious plan is adopted for separating this metal from its ores. The ores, after various preparations, are mixed

with mercury, which amalgamates with the silver; the amalgam so formed is then run off, and subjected to fire, which drives off the mercury in vapour, leaving the silver nearly in a state of purity. Silver is never used quite pure, but always alloyed with copper, to render it harder and more durable. It is not affected by any of the substances generally used as food; hence, being at once cleanly and beautiful, it is admirably adapted for culinary and domestic purposes. It is also formed into vases, candelabra, statues, and other ornamental articles. As a medium of exchange it was used as early as the days of Abraham (Gen. xxiii. 15, 16).

Copper, if not the most important of the metals, is unquestionably one of very general utility. It is highly malleable, flexible, and ductile, harder and more elastic than silver, more fusible than iron, and the most sonorous of all the metals. It occurs native in many parts of the world. In America, large masses of native copper are met with, sometimes lying on the surface of the soil. The most abundant ore of this metal is usually known as *yellow copper*, or *copper pyrites*, and contains nearly equal quantities of copper, iron, and sulphur. It is found in various localities, both in our own and other countries. A richer but less plentiful ore of copper is the *red oxide*, which yields four-fifths of its own weight of metal.

Copper and its alloys are applied to purposes innumerable. We cover the hulls of ships with plates of it, and we form it into cauldrons, distilling apparatus, cooking utensils, &c. For the latter purpose it is, to a certain extent, dangerous; one of its salts, called *verdigris*, which it generates when acted on by certain acids, being a virulent poison. Hence the inside of copper vessels is usually coated with tin. An immense quantity of copper is used for coin, for which purpose it is generally more or less alloyed. Its alloys are, indeed, still more important than the metal itself. It would be impossible to enumerate all the articles, from a pin to a cannon, which are made of alloys of this metal with tin or zinc, or both together, and occasionally with nickel, lead, and iron. These alloys are known under various names,

such as brass, bronze, bell-metal, gun-metal, pinchbeck, German silver, &c.

Tin has long been known and worked in this country. It was the tin mines of Cornwall that first led the Phœnicians, the great merchants of ancient times, to visit our island shores. The only important ore of tin is an oxide, of which the metal forms about three-fourths by weight. It is found in abundance in various countries; the mines of Cornwall alone yield 5000 tons annually. Some of the uses of this metal have been already mentioned. It is, besides, largely employed for covering sheet iron, which, when so covered, is called tin-plate. This tinned iron is manufactured into cheap and useful articles for domestic purposes.

Lead is a well known metal, proverbially heavy, very malleable, but soft and inelastic. It is said to be found native in lava, but it is chiefly procured from a sulphuret called *galena,* of which (as already stated) some varieties contain silver as well as lead. The lead mines of Britain produce in one year little less than 100,000 tons. It can scarcely be necessary to dwell upon the uses of this metal. Roofs of houses are covered with it, and gutters are made of it to carry off the rain that collects on slates or thatch. Water pipes and tanks, window frames, coffins, bullets for guns and pistols, shot, and many other articles, are also made of lead. It is worth while to add that an alloy of lead and antimony is used for printing-types, to which the civilization of the world is so much indebted.

IRON.

Iron is by far the most important of all the metals. It pervades, more or less, almost every object in nature. It exists both in plants and animals, and it is the colouring matter of many earths and stones. So extremely various are the forms in which it occurs, and so different the proportions in which it is combined with other minerals, that it is difficult to separate the ores of iron from those sub-

stances in which the metal is merely an accidental or accessary ingredient.

Iron occurs native, but not abundantly. Curious masses of it are sometimes found lying on the surface of the ground, and are believed to have fallen from the sky; whence they have come it is very difficult to say. The iron of these remarkable productions is called *meteoric*.

Among the ores of iron, which are numerous and extremely various, there are two important oxides, distinguished as the *black oxide*, *magnetic iron ore*, or *loadstone*, and the *red oxide*, or *hæmatite*. The former is remarkable for the possession, in its natural state, of those properties from which the needle of the mariner's compass derives its value. It is the principal ore of iron in Norway, Sweden, and Russia, and the iron manufactured from it, in these countries, is of the very best quality. A beautiful crystallized variety of the red oxide, called *specular iron ore*, is found in many parts of Europe. The finest specimens are from the island of Elba, in which valuable iron mines have been worked from a remote period. Similar in composition is common hæmatite, which, as the name implies, is usually of a blood-red colour, though the same name is applied, not quite properly, to other varieties of darker hue.

To us in this country, the most interesting ores of iron are carbonates more or less pure. One of these, called *spathose iron ore*, not only yields the best iron for conversion into steel, but is itself a kind of natural steel. But almost all the iron manufactured in Great Britain is obtained from an impure carbonate, called *clay ironstone*. It contains from 25 to 40 per cent. of metal, mixed with carbonaceous and clayey substances. The importance of this mineral may be conceived from the fact, that it yields, in Britain alone, from three to four millions of tons of iron every year.

The process by which the iron is manufactured is called *smelting*. In huge conical kilns of brick, built expressly for the purpose, the smelting fires are kept burning incessantly for years together, their lurid gleams lighting up the sky,

in the night-time, to a distance of many miles. The materials are supplied from above, and through an opening at the bottom the melted iron is, from time to time, run off into moulds of sand. Here it cools in the form of short bars called *pigs*. This pig iron is also called *cast* iron, and may be again converted, by various processes of melting and hammering, into *malleable* iron, which differs from cast iron in being softer and more tenacious. Steel is a compound of iron with carbon; it is prepared by embedding bars of malleable iron in powdered charcoal, and exposing them for many hours to an intense heat.

Of the importance of iron in commerce and the arts it is not easy to form an adequate conception. It is extensively employed in war as well as in the pursuits of peace. Swords, sabres, and bayonets, are made of iron in the form of steel. Showers of iron shot and shell, discharged by cannon and mortars of iron, spread death on many a battle-field. And on the sea, if not on land, it affords also the chief means of defence. Iron monsters of invulnerable strength are fast taking the place of our "wooden walls." But the same substance is also formed into many objects tending to unite mankind into one great community of friends. Railways are now so numerous, that the quantity of iron required for these extraordinary creations of our time is immense. Add to this the thousands of miles of iron pipes for the distribution of water and gas in our towns; the bridges, pillars, railings, and balconies; the chains, wire-ropes, and wire for every conceivable purpose; the iron bedsteads for hospitals, barracks, and private houses; the grates, stoves, fire-irons, and culinary vessels; the ploughs, scythes, spades, and agricultural implements of every variety; machinery of all kinds; tools for every species of handicraft; horse-shoes and tires of wheels; springs of all sorts, from the ponderous and powerful springs of railway carriages to the feather springs of our chronometers and watches; and the countless myriads of nails, screws, needles, and articles of cutlery of every description.

It is a very fortunate circumstance, that in most cases

the ironstone, and the coal necessary for smelting it, are found in the same locality. The coalfields of central Scotland, Staffordshire, and South Wales, supply a large proportion of the iron produced in the United Kingdom. Indeed, these two minerals, coal and iron, form together one of the chief sources of our country's greatness. If Providence has denied us mines of gold, there is ample compensation in these rougher substances, and in the admirable sagacity, a much richer present of the Creator, which enables us to turn His gifts to so good account.

QUESTIONS FOR EXAMINATION.

When are metals said to be native? What is an ore? an alloy? an amalgam? Name the most important metals. Where do we get platinum? Describe it. What is it used for? Where do we get most of our gold? For what qualities is gold remarkable? Why is it well suited for coinage? What is the principal ore of mercury? Where does copper occur native? For what purposes is it used? From what ores is silver obtained? How is it separated from them? Why is it suitable for domestic articles? Does copper occur native? Where? From what ores is it obtained? What is it used for? What alloys of copper are important? Where are there tin mines? What is the chief ore of lead? What is lead used for? Which is the most important of the metals? Describe its ores. Which ore of iron is chiefly worked in Sweden? in Russia? in Britain? How is the iron separated from its ores? Distinguish between cast iron, malleable iron, and steel. What are meant by pigs of iron? Show that iron is very useful.

NELSON.

Horatio Nelson, England's greatest naval hero, was the fourth son of the Rev. Edmund Nelson, rector of Burnham Thorpe, in Norfolk, where Horatio was born in 1758. He received his early education first at Norwich, and next at North Walsham; but in his twelfth year he became a midshipman under his uncle, Captain Suckling, of the "Raisonable." Soon after this he sailed to the West Indies in a merchant ship, and on his return was admitted on board the "Carcass," one of the vessels sent on an expedition to the North Pole, under the orders of Captain Phipps. In 1777 he obtained the rank of lieutenant, and in 1779 that of post-captain.

At the commencement of the war with France he was nominated to the "Agamemnon" of 64 guns, on board of

which he sailed to the Mediterranean, and was at the taking of Toulon. He was also present at the siege of Bastia, where he served at the batteries with a body of seamen; and while thus employed he lost an eye. While on that station his daring intrepidity and unceasing activity were such, that his name was dreaded throughout the shores of the Mediterranean. In 1796 he was appointed commodore on board "La Minerve." Soon after this he descried the Spanish fleet, and steered with the intelligence to Sir John Jervis, off St. Vincent. He had scarcely done so when the enemy hove in sight, and a close action ensued, in which Commodore Nelson greatly distinguished himself, having boarded and captured no fewer than three of the enemy's ships. For his share in this glorious victory, the commodore was honoured with the order of the Bath; and having soon afterwards hoisted his flag as rear-admiral of the blue, he was appointed to command the inner squadron at the blockade of Cadiz.

The next exploit in which he was engaged was an attempt to take possession of Teneriffe; which design failed, and Nelson lost his right arm by a cannon-shot, and narrowly escaped with his life by the devotion of his step-son, Captain Nisbet, who carried him off on his back to a boat, after lying senseless and exhausted for several hours upon the ground. In 1798 he was sent up the Mediterranean, to watch the progress of the armament at Toulon, destined for the conveyance of Buonaparte and his army to Egypt. Notwithstanding the strictest vigilance, this fleet found means to escape, but was followed by Nelson, and, after various disappointments, traced to the bay of Aboukir. Here he commenced an immediate attack, and by a manœuvre of equal boldness and ability, sailed between the enemy and the land, though exposed to a double fire. The result was a victory so glorious and decisive, that all the French vessels, with the exception of two men-of-war and two frigates, were taken or destroyed. This achievement was rewarded with the title of Baron Nelson of the Nile, and an additional pension of £2000, besides the estate and duke-

dom of Bronte in Sicily, and high honours conferred by the Turkish Sultan. On his return to England he was received with enthusiastic joy, and was created Viscount.

In 1803, hostilities again recommencing with France, he sailed for the Mediterranean, and took the command of that station on board the "Victory." Notwithstanding all his vigilance, the French fleet escaped from Toulon, and was joined by that of Cadiz; of which being apprised, he pursued them to the West Indies with a far inferior force. The combined squadrons, struck with terror, returned without effecting anything; and Admiral Nelson, after visiting England, again joined his fleet off Cadiz. The French under Admiral Villeneuve, and the Spaniards under Gravina, ventured out with a number of troops on board, Oct. 19, 1805, and on the 21st, about noon, the action began off Cape Trafalgar. Lord Nelson ordered his ship, the "Victory," to be carried alongside his old antagonist, the "Santissima Trinidada," where he was exposed to a severe fire of musketry; and not taking the precaution to cover his coat, which was decorated with his star and other badges of distinction, he became an object for the riflemen placed purposely in the tops of the "Bucentaur," which lay on his quarter. In the middle of the engagement, a musket-ball struck him on the left shoulder, and passing through the spine, lodged in the muscles of his back. He lived just long enough to be acquainted with the number of ships that had been captured, and his last words were, "I have done my duty; I praise God for it."

The mighty spirit of Nelson was epitomised in the signal which he hoisted on commencing this action—"England expects that every man will do his duty!"—a sentence that not only testified the pure Spartan love of country which animated his own breast, but proved the philosophical tact which inspired him to strike upon the strongest chord that could vibrate in every surrounding bosom. His remains were brought to this country, and buried with unprecedented honours in St. Paul's cathedral, where a suitable monument has been erected to his memory.

DEATH OF NELSON.

THE death of Nèlson| was felt in Éngland| as something móre than a pùblic calamity; mén stàrted at the intèlligence, and turned pàle, as if they had heard of the lóss of a dear friend. An object of our admirátion and affèction, of our pride and of our hópes, was suddenly tàken from us; and it seemed| as if we had never till thèn known| how deèply we lóved and rèverenced him. What the country had lost in its great naval héro—the greatest of our òwn and of all fórmer times—was scarcely taken into the accoùnt of grief. So pèrfectly, indeed, had he performed his párt, that the màritime war, after the battle of Trafálgar, was considered at an ènd. The fleets of the enémy| were not merely deféated, but destròyed; new návies| must be built, and a new race of seàmen réared for them, before the possibility of their invading our shóres| could again be contèmplated. It was not, therefore, from any sèlfish reflection upon the magnitude of our lóss that we mourned for him: the géneral sorrow| was of a hìgher character. The people of England gríeved| that funeral cèremonies, and public mònuments, and posthumous rewárds, were all that they could nòw bestow upon hím| whom the kìng, the lègislature, and the nátion| would have alike delighted to honour; whom every tóngue would have blèssed; whose prèsence, in every village through which he might have pássed, would have wakened the chùrch-bells, have given school-boys a hòliday, have drawn chíldren from their spòrts to gáze upon him, and òld men from the chimney-córner| to look upon Nélson ere they dìed. . . . There was reason to suppòse, from the appearances upon opening his bódy, that, in the course of náture, he might have attained, like his fáther, to a good old agè. Yet hè cannot be said to have fallen prematúrely, whose work was dòne; nor ought hè to be lamented, who died so full of hónours, and at the height of human fàme. The most triúmphant death| is thát of the màrtyr; the most áwful, thát of the martyred pàtriot; the most spléndid, that of the héro in the hour of vìctory;—and if the chariot and

the horses of firè had been vouchsafed for Nelson's translátion, he could scarcely have departed in a brighter blaze of glòry. He has left us, not indeed his mantle of inspirátion, but a nàme and an exámple which are at this hóur inspiring thóusands of the youth of England—a nàme which is our príde, and an exámple which will contìnue to be our shíeld and our strèngth.

SOUTHEY.

THE MARINERS OF ENGLAND.

Ye mariners of England!
 That guard our native seas;
Whose flag has braved, a thousand years,
 The battle and the breeze!
Your glorious standard launch again,
 To match another foe!
And sweep through the deep,
 While the stormy winds do blow;
While the battle rages loud and long,
 And the stormy winds do blow.

The spirits of your fathers
 Shall start from every wave!—
For the deck it was their field of fame,
 And ocean was their grave:
Where Blake and mighty Nelson fell,
 Your manly hearts shall glow,
As ye sweep through the deep,
 While the stormy winds do blow,
While the battle rages loud and long,
 And the stormy winds do blow.

Britannia needs no bulwarks,
 No towers along the steep,
Her march is o'er the mountain-waves,
 Her home is on the deep.
With thunders from her native oak,
 She quells the floods below,—

As they roar on the shore,
  When the stormy winds do blow;
When the battle rages loud and long,
  And the stormy winds do blow.

The meteor-flag of England
  Shall yet terrific burn;
Till danger's troubled night depart,
  And the star of peace return.
Then, then, ye ocean-warriors!
  Our song and feast shall flow
To the fame of your name,
  When the storm has ceased to blow;
When the fiery fight is heard no more,
  And the storm has ceased to blow.

CAMPBELL.

PROGRESS OF SOCIETY.

In barbarous countries we find men scattered in small numbers over a wide extent of territory, living by hunting or fishing, or both combined; every man supplies his own wants directly; he makes his own bow and arrows; he kills a buffalo for himself; with hides stripped and dressed by himself, he constructs his own robe or tent; he lives from hand to mouth, feasting voraciously to-day, then starving till another supply of food can be obtained; ever on the verge of famine, and eking out a precarious subsistence by robbery and murder, which he calls war. All but the strong perish in early years, and the average duration of life is low. If we contemplate the pastoral life instead of that of hunting and fishing, still we find that large tracts of country are needed for the maintenance of few people. If the earth is at all cultivated, it is with the rudest implements, and the produce is proportionally scanty. So long as each man is entirely occupied in providing for his own wants, progress is impossible. So soon, however, as by the gradual and slow introduction of better implements, and the acquirement

of greater skill, agriculture becomes more productive, and the labour of one man becomes sufficient for the support of more than one,—the first condition of progress is realised, and the labour of some is now set free for other occupations. Food and clothing, fuel and shelter, are the first necessaries of life. But instead of every man preparing all these for himself directly—instead of every man making for himself all that he requires, gradually one man begins to construct one article or set of articles only, while another devotes himself to another, with a consequent great increase of productiveness in each case, from increased skill and economy of time; in other words, the *division of labour* is begun. But so soon as the industry of the community is thus divided, and that of each thus restricted, as each still requires all the articles which before he constructed for himself, he can obtain them only from those who employ themselves in their production, and this he can do only by giving some of his own product as an equivalent—in other words, by *exchange*. Division of labour and exchange are thus simultaneous in their origin. From the introduction of exchange, industrial progress gains a fresh life. Industry having been thus rendered more productive than before, subsistence is now provided for a larger number of persons. The reward of industry increasing with its productiveness, ingenuity is stimulated to the invention of improved methods, and of improved instruments called *tools*, or *machines*.

Population, having meantime increased, the land available for production becomes more and more fully appropriated; and as one portion is more fertile, or more advantageously situated than another, it becomes more advantageous to pay a portion of the produce for the right to cultivate a more productive soil, than to cultivate an inferior one even for nothing; for instance, to pay ten measures of grain for a soil which produces fifty measures, than nothing for a soil which produces, say, thirty or thirty-five; and hence arises what we call *rent*. But, meantime also, the productiveness of industry having become greater in proportion to the con-

sumption of its produce, the process of accumulation goes on, and the unconsumed results of previous labour swell to larger proportions.

As industry extends and wealth increases, it is early found necessary to provide for the security of property, for the suppression of violence and fraud, and for the settlement of disputes that will here and there arise, even without evil intention on either side. Hence all the machinery of courts of justice, and of government, from its highest to its lowest functionary. As these, though not in themselves directly producers, are indispensable to production, and exist for the welfare of all, they must be maintained at the expense of all; hence comes taxation of various kinds, which it is the business of the legislature to impose justly, and in the way least likely to fetter industry, and prevent increase of wealth.

DR. HODGSON.

THE SONG OF THE SHIRT.

[THOMAS HOOD was the son of a bookseller in London. He was born in 1798, and died in 1845. He abandoned his original profession of an engraver when he witnessed the popularity of his sportive muse. Hood is chiefly distinguished as a punster and a satirist, but some of his smaller pieces, such as "The Song of the Shirt," are stamped with the purest character of poetry.]

WITH fingers weary and worn,
With eyelids heavy and red,
A woman sat in unwomanly rags,
Plying her needle and thread.
Stitch! stitch! stitch!
In poverty, hunger, and dirt,
And still with a voice of dolorous pitch
She sang the "Song of the Shirt!"

Work! work! work!
While the cock is crowing aloof!
And work! work! work!
Till the stars shine through the roof!

It's oh! to be a slave
Along with the barbarous Turk,
Where woman has never a soul to save,
If this is Christian work!

Work! work! work!
Till the brain begins to swim;
Work! work! work!
Till the eyes are heavy and dim!
Seam and gusset and band,
Band and gusset and seam,
Till over the buttons I fall asleep,
And sew them on in a dream!

Oh, men! with sisters dear!
Oh, men! with mothers and wives!
It is not linen you're wearing out,
But human creatures' lives!
Stitch! stitch! stitch!
In poverty, hunger and dirt,
Sewing, at once, with a double thread,
A shroud as well as a shirt.

But why do I talk of Death,
That phantom of grisly bone?
I hardly fear his terrible shape,
It seems so like my own—
It seems so like my own,
Because of the fasts I keep,
Oh, God! that bread should be so dear,
And flesh and blood so cheap!

Work! work! work!
My labour never flags;
And what are its wages? a bed of straw,
A crust of bread and rags.
That shatter'd roof—and this naked floor—
A table—a broken chair—
And a wall so blank, my shadow I thank
For sometimes falling there!

Work! work! work!
  From weary chime to chime,
Work! work! work!
  As prisoners work for crime!
Band and gusset and seam,
  Seam and gusset and band,
Till the heart is sick, and the brain benumbed,
  As well as the weary hand.

Work! work! work!
  In the dull December light;
And work! work! work!
  When the weather is warm and bright!
While underneath the eaves
  The brooding swallows cling,
As if to show me their sunny backs,
  And twit me with the spring.

Oh! but to breathe the breath
  Of the cowslip and primrose sweet!
With the sky above my head,
  And the grass beneath my feet.
For only one short hour
  To feel as I used to feel,
Before I knew the woes of want,
  And the walk that costs a meal!

Oh! but for one short hour—
  A respite, however brief!
No blessed leisure for love or hope,
  But only time for grief!
A little weeping would ease my heart,
  But in their briny bed
My tears must stop, for every drop
  Hinders the needle and thread!

With fingers weary and worn,
  With eyelids heavy and red,
A woman sat in unwomanly rags,
  Plying her needle and thread.

Stitch! stitch! stitch!
In poverty, hunger, and dirt,
And still with a voice of dolorous pitch,
Would that its tone could reach the rich!
She sang this "Song of the Shirt."

HOOD.

FIRST NOTIONS OF GEOLOGY.

Agglomerate, (*ad, glomus*, L.) to collect into a mass.
Aqueous, (*aqua*, L.)
Detritus, (*de, tero*, L.) the waste of rocks, &c., washed down by streams.
Fossil, (*fodio*, L.) *Lit.* anything dug out of the earth.
Fusion, (*fundo*, L.) the state of being melted.
Geology, (*ge, logos*, G.)
Igneous, (*ignis*, L.)
Metamorphic, (*meta, morphe*, G.)
Naturalist, one who studies natural history.
Oolite, (*oön, lithos*, G.) egg-stone—so called from its resemblance to the roes of fishes.
Petrified, (*petros*, G.) turned into stone.
Phenomenon; Plur. *Phenomena*, (*phaino*, G.) an appearance.
Primary, (*primus*, L.) first in order.
Schist, (*schizo*, G.) a kind of stone easily split.
Secondary, (*secundus, sequor*, L.) next to the primary.
Stratum, (*sterno*, L.) a bed or layer. Hence *stratified, unstratified, stratification*.
Tertiary, (*tertius*, L.) next to the secondary.
Transition, (*trans, eo*, L.)
Volcano (*Vulcanus*, the god of fire, L.) a burning mountain. Hence *volcanic*.

HOW ROCKS ARE FORMED.

THE *crust* of the earth is that portion of it, from the surface downwards, which man has been able to explore. It is the business of *geology* to inquire of what materials this crust is composed, and how they have come to assume the forms in which we now find them. These materials are all included under the general name of *rocks*. It is not necessary that a substance be hard and stony, in order to be called by geologists a *rock*, for they apply the name to sand, clay, and mud, as well as to granite and limestone.

As the earth has a diameter of nearly 8000 miles, it is obvious that only a very small portion of its whole mass is accessible to us. Of its vast interior we know nothing with certainty. There are, indeed, plausible grounds for conjecturing that, beyond a certain depth, stones, metals, and all other substances, are in a state of fusion, and that the

centre of this our fair world is nothing else than a huge cauldron of liquid fire. Though this is by no means certain, it cannot be doubted that there are in its interior more or less extensive reservoirs of melted matter, which now and again finds its way to the surface. It is by the action of these internal fires that such phenomena as volcanoes and earthquakes are accounted for.

Volcanoes throw out immense quantities of dust, mud, and liquid matter called *lava*, which spread over the surrounding country, and solidify into rocks. By these substances the surface of a large district is often completely changed. The courses of streams are diverted, and sometimes so obstructed that the water accumulates and forms lakes. Valleys are filled up, trees and fields buried, and whole towns submerged beneath the fiery torrent. Such is one of the causes that contribute to the formation of rocks.

The rocks which owe their origin to the agency of fire are called *igneous*, and are found in many places where no volcanoes are known to have been in actual operation within the period embraced by historic records. They are usually hard, of rugged and irregular outline, and more or less crystalline in structure. The granite, porphyry, whinstone, and basalt, of which our sublimest and most picturesque hills, cliffs, and caverns are formed, bear evident marks of igneous origin, whether they were produced by volcanic fires, or by the action of the same element on a still grander and more extensive scale.

But there is another and quieter agency by which a great proportion of the rocks of the earth have been produced. We are wont to speak of the "everlasting hills," without thinking that every one of our hills is constantly wearing away. But we cannot help seeing, if we will take the trouble to consider the matter, that this is the case. The streams which run down their sides have hollowed out for themselves channels that are ever deepening. When swollen by rains, the quantity of *detritus* which they carry down is often astonishingly large. But, even in their ordinary state, there is always more or less waste of the rocks

and stones over which they flow, an unceasing transportation of matter towards the sea. Again, the moisture of the atmosphere penetrates many hard and solid rocks, and, when frost sets in, expands (as water in freezing always does) with a force sufficient to loosen little fragments, which soon fall off, and crumble into sand. Slowly, yet surely, this sand is washed down by rains, first into the nearest stream, and thence onwards to the sea.

The sea itself, too, is constantly eating up the land. Where the coast is low and sandy, this process goes on rapidly, but it is distinctly visible even on the rockiest shores. The waves, breaking against the bottom of the cliffs, gradually undermine them, so that fragments from time to time tumble down from above. These are exposed to the action of the ever-returning waters, the smaller pieces being dashed backwards and forwards till every corner is rubbed off, and they become as smooth and round as art itself could make them. The sandy matter which this constant wear produces, is deposited, like the detritus of rivers, in the bottom of the sea. There, in the course of long ages, are formed thick layers of sand, mud, stones, and other substances, which gradually consolidate into rocks. Such rocks, being formed by the action of water, are called *aqueous*.

This process of disintegration, to which the surface of the earth is everywhere exposed, is slow indeed, but it is unceasing. The dry land is daily crumbling away; and were there no counteracting influence, every continent and island would at length disappear, and again, as of old, when the fountains of the great deep were broken up,

"A shoreless ocean tumble round the globe."

ARRANGEMENT OF ROCKS.

It is to the earthquake and similar agencies, the result of subterranean forces, that we are indebted for counteracting

those disintegrating processes, which tend to reduce the earth's surface to one common level. The influence of earthquakes on the general configuration of a country is prodigious, the whole slope and drainage being sometimes changed. Large tracts of ground are often elevated by these terrible phenomena above their former level, and often depressed below it. Even when there is no sudden or violent convulsion, such elevations and depressions frequently go on gradually and in silence, till what was once the bottom of the sea comes to be the mountain top. So extensive have such changes been, that there is probably no part of the earth's surface which has not been long under water, and no part of it which has not at some time or other been dry land. Thus it is that aqueous rocks are found at great distances from the sea.

It is believed that nearly all the rocks of the earth's crust have been produced by such causes as were described in last lesson, acting through cycles of immense duration, too vast for human minds to grasp. If we keep this in view, and remember also how the earthquake and kindred forces suddenly or gradually disturb levels, and alter the boundaries of land and sea, we shall the more easily comprehend the order in which the various kinds of rock are now actually found to occur.

Lowest and most ancient are igneous rocks, forming, as it were, the groundwork or basis on which the superstructure of the earth's crust is built. Of these the chief varieties have already been mentioned. The aqueous rocks are piled above them in layers or *strata*, originally horizontal, like courses of stupendous masonry. Hence the aqueous rocks are also called *stratified*, whilst the igneous, consisting of matter agglomerated without any semblance of order, are said to be *unstratified*.

The difference in composition and appearance between the successive strata, prove that they have been deposited at different times, and under different circumstances. The lowest are usually known as *transition* or *metamorphic* rocks, inasmuch as they correspond in character partly with the

igneous rocks immediately beneath, and partly with those incumbent upon them. They seem to have been originally formed by deposition, but afterwards altered by the action of fire. The chief varieties are gneiss, slate, and mica-schist.

Next in order, as we proceed upwards, are the rocks called *primary*.* They include the Silurian strata, the old red sandstone, the mountain limestone, and the coal measures. Above these are the *secondary* rocks, comprehending the new red sandstone, oolite (a kind of limestone), and chalk. Last of all come the *tertiary* rocks, consisting of several later formations, over which are spread various sands, gravels, clays, peat-mosses, and other accumulations of historic times.

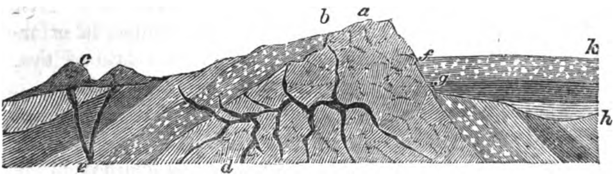
It does not necessarily follow that all these strata are found together in every, or even in any locality. One or more of the series may be wanting, but the natural order of those which do occur is never inverted. Thus, if we take the letters of the alphabet to represent the strata in the order of their formation, H may come immediately after A, but can never come before F or G. We may have such a sequence as A, P, T, but never A, T, P. This is a point of great importance. For example, the coal measures lie below the new, but always above the old red sandstone. If, then, in any locality, we have the latter at the surface of the ground, it is hopeless to search for coal there; whereas, if the former be at the surface, there is a chance, but no certainty, that beds of coal will be found below.

It is obvious that all the strata, when originally formed, must have been horizontal; but, instead of this, they are now found with every variety of slope, having been upheaved and disrupted by forces acting from beneath. In many cases the igneous rocks have been forced up through the superincumbent strata, and form huge hills, on whose summits they appear at the surface, while the edges of the broken strata are ranged in order along the flanks. The

* It ought to be mentioned that there is a great want of uniformity among geologists in regard to the names by which different strata are distinguished. The *igneous* rocks, for example, are often called *primary*, and those here denominated *primary*, are then ranked among the *secondary*. By others, again, a totally different set of names is employed.

actual state of the earth's crust will be best understood by a reference to the accompanying illustration. At *a* (fig. 5), the igneous rocks are on the surface. The earliest or lowest strata begin to appear at *b*, and the edges of others are passed over in succession as we proceed towards *c*. The same strata occur, with a still greater slope, between *g* and

FIG. 5.



h; but here they are covered by later formations (*f*, *k*), whose horizontal position shows that they must have been deposited *after* the forces, by which the surrounding rocks were upheaved, had ceased to operate. The eminences at *c* are formed of volcanic matter, ejected through the opening seen at *e*; and the dark lines between *b* and *d* represent fissures in the various rocks, produced by earthquakes and similar convulsions, and then filled up, from subterranean treasures, with metallic ores and other substances in a state of fusion. It is from such fissures, usually called veins, that most of the metals and their ores are obtained.

ORGANIC REMAINS.

THE most remarkable phenomena, which an examination of the earth's crust presents to us, have not yet been referred to. At an early period in the formation of stratified rocks, vegetables had begun to clothe the surface of the earth, and animals to people its waters. Of these, and especially of the latter, the remains of successive generations were

buried in the deposits from which rocks were formed, and are still preserved, petrified and encased in the surrounding stone, as memorials of the early inhabitants of our globe. Such remains are known by the general name of *fossils*.

It is only by examining the fossils which rocks contain, that we can determine accurately to what period the rocks themselves belong. Strata which were unquestionably deposited at the same epoch are often composed of different materials; and, on the other hand, strata composed of the same materials sometimes differ widely in the date of their formation. This would lead to very great uncertainty in the whole science of geology were it not that fossil remains, of which each stratum has its own peculiar collection, afford evidence of a much more exact and reliable character.

In the lower strata of the primary rocks, fossils are not plentiful, and those that do occur represent only the humbler varieties of animal life. But, as we ascend, skeletons of huge fishes begin to be met with, and these are followed by a few species of reptiles, which seem to have been the first living inhabitants of the land. At the remote epoch to which we now refer, the earth must have been covered with a luxurious and splendid vegetation. The layers of coal, which abound in the upper primary formations, consist entirely of fossilized vegetables; and, as these layers are sometimes sixty feet in thickness, it seems difficult to explain how an accumulation of trees, plants, and foliage, could ever be produced in such enormous quantity. More than two hundred species of plants have been distinguished in the British coal measures, and far greater numbers in those of other countries. Thus we see that a beneficent Creator had stored up for the use of man, when as yet the race of man was not, vast supplies of this substance, so necessary to his comfort and progress in civilization.

The fossils of the secondary rocks are extremely varied and numerous, but still mostly limited to the lower orders of the animal creation. The first certain traces of birds are found in the chalk formation. Their number, however, is

very limited, until we come to the tertiary period. Then, for the first time, appear some of the same species of animals which still exist, and their number gradually increases till the latest strata are reached. The former inhabitants of the globe differed from the present in many of the minuter details of their structure, though they agreed in all the more essential principles.

But besides the occasional occurrence, in all these strata, of organic remains, immense layers of rock are entirely formed of animal and vegetable substances. Coal has been already mentioned. The limestone, with which it is often associated, is composed, to a large extent, of minute shells and corals, the remains of animals which could have lived only in the sea. Even at the present day, the coral is building up, throughout the Pacific Ocean, rocks and islands of great extent, which may become the continents of future ages. A celebrated naturalist mentions a stratum of rock in Germany, not less than fourteen feet in thickness, which is composed exclusively of the shells of animalcules, so minute that 40,000,000,000 of them would not fill a space greater than a cubic inch!

Since each stratum contains the remains of the organized tribes which inhabited the earth at the time of its deposition, we have, in these remains, so many museums presenting to us specimens of the zoology and botany of the globe in successive ages of its history. It is remarkable that among the numberless varieties of these fossils, no trace of man has ever been found, except in the accumulations which have been deposited since the present order of things commenced. Thus science coincides with revelation in testifying that man is the latest, as he is the noblest, of God's creatures upon earth.

Many have rashly and impiously argued that the discoveries of geology are at variance with the history of creation revealed to us in the Bible, but the most eminent geologists are of a different opinion. It is not our business here to enter on such a question, but we may rest assured that the Bible will never suffer from the discovery of truth.

QUESTIONS FOR EXAMINATION

Of what does geology treat? What is meant by the crust of the earth? What substances do geologists call rocks? What do we know of the earth's interior? State some of the effects of volcanoes. What rocks owe their origin to subterranean fire? What are aqueous rocks? Explain how the dry land is being disintegrated? What would follow if this disintegration were not counteracted? What counteracts it? State some of the effects of earthquakes. Why are aqueous rocks sometimes found far from the sea? What are strata? Which rocks are stratified? Which unstratified? What are transition rocks? primary rocks? secondary rocks? tertiary rocks? Why were all the strata originally horizontal? Why not so now? What are fossils? What rocks are formed entirely of fossilized vegetables? of fossilized animals? Are there any human fossils? What is inferred from their absence?

GOD HATH A VOICE.

[ELIZA COOK, the daughter of a tradesman in Southwark, London, was born in 1817. The "Old Arm Chair," "Old Farm Gate," and many other of her pieces are stamped with the truest character of poetry, and are universally admired.]

GOD hath a voice that ever is heard
In the peal of the thunder, the chirp of the bird;
It comes in the torrent, all rapid and strong,
In the streamlet's soft gush as it ripples along;
It breathes in the zephyr, just kissing the bloom;
It lives in the rush of the sweeping simoon;
Let the hurricane whistle, or warblers rejoice,
What do they all tell thee but God hath a voice?

God hath a presence, and that ye may see
In the fold of the flower, the leaf of the tree;
In the sun of the noonday, the star of the night;
In the storm-cloud of darkness, the rainbow of light;
In the waves of the ocean, the furrows of land;
In the mountain of granite, the atom of sand;
Turn where ye may, from the sky to the sod,
Where can ye gaze that ye see not a God?

ELIZA COOK.

SECTION II.

MUSIC AS A BRANCH OF EDUCATION.

"Mòst persons sáy, that the ònly purpose of músic| is to amùse; but thís| is a profáne, an unhòly language. To look on music as mere amúsement| cànnot be justified. Mùsic which has no óther aim, must be considered neither of válue, nor worthy of rèverence." Thús spake Plàto; and his opinion is shared by thóse| who are striving to spread music among the péople| in the prèsent day.

The physical órgans| and aptitudes of ear and vòice| required for vocal músic| are stíll very gènerally regárded| as pecùliar endowments, rare gífts, possessed only by a fèw; whereás, in truth, they are the very sàme as those used for spéaking and heàring, the common inhéritance of mankìnd. Every child, not born deaf or dúmb, is born with those órgans| which may be taught to sìng as well as to speak. It is by the teaching of exâmple| that the child attains the power of speèch; but the sàme opportunities are seldom gíven| to devélop the faculty of sòng. When this teaching has been neglected till advanced áge, the vocal organs become less fléxible| and less obedient to the wìll, and the art of sínging| increasingly difficult to commènce. But even in thèse cases, pàtience, effort of mìnd, and a good méthod, will awaken to creditable úse| the neglected fàculty. There ìs, doubtless, a great dìfference in the physical constitution of indivíduals, which gives to sòme| a much greater nervous susceptibility and consequent delicacy of ear and voice than óthers; but àll mankind are endowed by the Creátor| with that glorious faculty of sóng, which Hé has made it our dùty| to impróve for his pràise. There is therefore no

deficiency of natural voice or éar| to account for the common neglect of mùsic: nor is there among the péople| any general unwìllingness to learn músic, which is beautiful and attractive to àll; nor can any difficulty in the nature of music itsélf be pleaded, for, considered as an árt, it is certainly more easy than reàding, wríting, or dràwing; and as a scíence, it is most sìmple in its eléments, however rich and váried in its combinàtions.

The music, for which wé contend, is linked with pòetry, and employed to carry to the héart| some cheerful sèntiment, some lofty thóught, or some ennobling emòtion. The importance, to educàtion, of music thús understood, cannot well be overràted. It occupies groùnd, in sóme degree peculiar to itsèlf—gróund|' which it is very important to occupy ríghtly in these tìmes. Sòme advantages it brings to phýsical, and mány, when rightly stúdied, to intellèctual education; but it displays its chíef power|, on the field of æsthètics, mórals, and relìgion.

In *æsthétic education,* it unites with the art of dràwing and the study of the finest models of líterature, to develop the love of whatsoever is òrderly, suìtable, harmónious, beaútiful, and sublìme. This is a branch of educátion| which the defenders of trúth| cannot, in thése days, well afford to neglèct.

In *móral education,* it joins with pòetry| to win the attention of yóuth, by the innocent beguilement of their united chárms, to truths and dúties| too often not òtherwise attractive. By the sáme means| it delàys the attention on these truths, and, moreover, secúres for them| the irresistible pówer| which belongs to constant reiteràtion. It possesses also that mighty sympathetic ínfluence, which the simple *expression of feèlings* carries with it to the heart of a chíld, whose ìnterest has been gained. We beguile him to utter, in the voice of a pleasant sóng, the language of some good emótion or some noble sèntiment, and, almost insensibly, he is won to join in the féelings| he finds it so pleasant to exprèss. This is a pówer| which is felt by us àll, and which is gréater than many àrguments. That which the teacher's moral lésson has explained and enforced, the moral sòng

shall impress on the mémory and endéar to the hèart. In a sìmilar manner| do mùsic and póetry contribute their aíd| in dírectly relìgious education. They impress more déeply| truths already taùght; they give a language to the faíth, and hòpe, and lòve, and jòy of youthful píety; they elevate the mínd, and help to raise the heart to Gòd. None but the heartless or the unwìse| can doubt the power for good or évil| which music and poetry are constantly exerting on educàtion, or fail to see the importance of earnest study and watchful cáre, that this pówer| may be well applìed.

In *phýsical education*| sìnging, as well as the useful practice of reading alóud, promotes a healthy action of the lúngs and of the muscles of the chèst,—most impòrtant in a cóuntry where consúmption lurks for its prèy. Musìc is well knówn| to possess a dirèct, though unexplàined, influence on the human nerves. It soothes the wéary or the excited fràme. It promotes the héalth| by recreating the mìnd. And not the leàst of its educating advántages is, that it oftentimes preòccupies and redeèms hours of léisure, which might othèrwise have become hours of ídleness or sìn. How good for bódy and mìnd| is the song round the cottage heárth, when the hours of labour are òver! God has made our chéapest pleasures| to be our bést and pùrest.

In *intelléctual education*, músic| bears no unwòrthy part. It cultivates the habit of atténtion and the powers of percéption and imitàtion, and it will teach, by example, how to observe in musical phenómena, and how to reàson upon them. Every subject should be só taught| as to improve the pupil's thìnking powers, and music gives better scope than is usually suppósed| for such an èxercise.

The habit of committing poetry to mèmory, which must always accompany the extended and varied use of vocal músic, has a direct tendency to promote a correct knówledge| and a fit applicàtion of words—most important hélps| to intellèctual èducation. One who was both a poet and a philósopher| defined póetry| to be, "the best thóughts| in the fittest wòrds." It may be easily nóticed| that nearly all children spéak well| who have been in the constant habit of

repeating póetry' with any degree of propriety. The sàme practice, when properly diréeted, helps to refine the imagi-nátion, and to tráin it to ùseful pùrposes. That noble pówer' has its hùmbler offices in common lífe, which are of the utmost vàlue. When rightly cúltivated, it teaches us to associate good thoùghts and kindly féelings' with the ordinary incidents of every-day lìfe. It makes "the bést of èvery thing." It has been said to "oil the wheels of life's chấriot' on this jolty ròad." It glàddens, by associations of contentment and lóve, even the poòr man's boárd' with truest festive jòy. It adorns his cottage hóme' with hues of peace and hàppiness. It makes "the dear familiar fáce"' grow more beaútiful with àge. It throws on áll things' the glow of a chéerful affectionate mìnd. What teacher will not find even his òwn mind elevated and refíned' while he traces, with his children, the imagery, brightening with every word, of these beautiful lines,—

"Triumphal arch that fill'st the sky,
When storms prepare to part,"
&c., &c.. &c.

Compiled.

POETRY.

[Rev. Dr. William Ellery Channing, a celebrated Unitarian Minister, was born in Rhode Island, U.S., in 1780, and died in 1842. Educated at Harvard College, he abandoned the pròfession of medicine and prepared himself for the Unitarian ministry. His eloquence rendered him one of the most conspicuous men in America. His discourses are beautiful specimens of pulpit eloquence, but they savour more of the oratorical moralist, than the Christian preacher.]

Póetry' is òne of the great ínstruments' of the refìnement and exaltátion of socìety. It lifts the mínd' above ordinary lìfe, gives it a rèspite from depressing cáres, and awakens the consciousness of its affínity' with what is púre and nòble. In its legitimate and híghest efforts' it has the same tendency and aím with Christiànity; thát is, to spìritualize our nature. Póetry' has a natural allíance' with our best affèctions. It delights in the beauty and sublìmity of the outward creátion

and of the sòul. It indeed pourtrays with terrible ènergy| the excesses of the pássions; but they are pássions| which show a mighty nàture, which are full of pòwer, which command áwe, and excite a déep though shùddering sympathy. Its great tendency and púrpose| is, to carry the mínd| beyónd and abòve the beàten, dùsty, weary wálks of ordinary lìfe; to lift it into a purer élement; and to bréathe into it| more profóund and generous emòtion. It revéals to us| the loveliness of nàture, brings back the fréshness of youthful feèling, revives the rélish of simple pleàsures, keeps unquénched| the enthúsiasm which warmed the spring-time of our bèing, refines youthful lòve, strengthens our interest in human náture by vivid delineations of its ténderest and loftiest feèlings, knits us by new ties with universal béing, and, through the brightness of its prophetic vísions, helps fáith| to lay hold on the future lìfe.

The présent life| is not whòlly prosaic, precìse, tàme, and fínite. To the gífted eye, it abóunds in the poètic. The affections which spread beyond oursélves, and stretch far into futùrity; the workings of mighty pássions, which seem to arm the sóul| with almost superhùman energy; the innocent and irrepressible joy of ìnfancy; the bloòm, and búoyancy, and dazzling hopes of yòuth; the throbbings of the heart, when it first wakes to lóve, and dreams of a háppiness too vast for eàrth; wóman| with her beaúty, and gráce, and gèntleness, and fulness of feéling, and depth of affèction, and her blushes of pùrity, and the tones and looks which only a mòther's heart can inspíre;—thése| are áll poètical. It is not trùe| that the poet paints a life which does not exíst; he only extràcts and concéntrates, as it were, life's ethereal èssence, arrèsts and condénses its volatile fràgrance, brings together its scattered beaúties, and prolongs its more refíned but evanescent jòys; and in thís| he does wèll; for it is good to feel| that life is not whòlly usurped by cares for subsistence and physical gratificátion, but admits, in measures which may be indefinitely enlárged, sentiments and delíghts| worthy of a hìgher being. This power of pòetry| to refine our views of life and háppiness, is more and móre needed|

as society advànces. It is néeded| to withstand the encroachments of heartless and artificial mànners, which make civilizátion| so táme and unìnteresting. It is néeded| to counteract the tendency of physical scìence, which, being nów sought, not as fòrmerly| for intellèctual gratification, but for multiplying bodily cómforts, requires a nèw development of imaginátion, tàste, and póetry, to preserve men from sinking into an eárthly, matérial, epicurèan life.

DR. CHANNING.

BINGEN ON THE RHINE.

A soldier of the Lègion| lay dying in Algiérs,
There was làck of woman's núrsing, there was deárth of woman's teàrs;
But a còmrade stood beside him, while his life-blood| ebbed awáy,
And bent with pitying glánces, to héar what he might sày.
The dying soldier| fàltered, as he took that comrade's hánd,
And he sáid: "I never mòre| shall see my ówn, my native lànd:
Take a méssage and a tòken| to some distant friénds of mine,
For I was born at Bìngen—at Bíngen on the Rhìne.

"Tell my bróthers and compànions, when they meet| and crowd aróund,
To hear my mournful story, in the pleasant vineyard gróund,
That we fought the battle bràvely; and when the day was wón,
Full many a corse| lay ghastly pále, beneath the setting sùn.
And midst the dead and dýing| were sòme grown old in wárs—
The dèath-wound| on their gallant bréasts, the lást of màny scars;
But sóme were yoùng, and suddenly beheld life's morn declíne;
And òne| had come from Bíngen—fair Bíngen on the Rhìne!

"Tell my móther' that her òther sons' shall comfort her old
age,
And I' was aye a trùant bird' that thought his hóme a càge;
For my fàther was a soldier, and, even as a chíld,
My heart leaped forth' to hear him téll' of strúggles fierce
and wìld;
And when he dìed, and left us to divide his scanty hóard,
I let them tàke whate'er they wóuld, but képt my father's
swòrd;
And with boyish lóve I hùng it' where the bright light' used
to shíne,
On the cottage wall at Bíngen—calm Bíngen on the Rhìne!

"Tell my sìster' not to weèp for me, and sob with drooping
héad,
When the troops are marching hóme again, with glad and
gallant trèad;
But to lóok upon them proùdly, with a calm and stedfast
eýe,
For her bròther' was a sóldier too, and not afraid to dìe.
And if a còmrade' seek her lóve, I ask her in mỳ náme'
To listen to him kíndly, without regrét or shàme;
And to hang the old sword in its plàce (my fàther's sword
and míne),
For the honour of old Bíngen—dèar Bíngen on the Rhíne!

"There's *anòther*—not a síster; in the hàppy days' gone bý,
You'd have known her by the mérriment' that spárkled in
her eỳe;
Too innocent for cóquetry—too fond for idle scòrning;
O friend, I fear' the lìghtest héart' makes sometimes heávi-
est moùrning!
Tèll her' the last night of my lífe' (for ere this moon be
risen,
My bòdy will be out of paín—my soúl be out of prìson)
I dreámed' I stood with *hèr*, and saw the yellow sunlight'
shíne
On the vine-clad hills of Bíngen—fair Bíngen on the Rhìne!

"I saw the blue Rhíne' swéep alòng; I heàrd, or seémed to hear,
The German sòngs we used to síng' in chórus' sweet and cleàr;
And down the pleasant rìver, and up the slanting hìll,
That echoing chorus' soúnded, through the évening calm and stìll;
And her glad blue eyes' were òn me, as we passed with friendly tálk
Down many a path beloved of yóre, and well remembered wàlk;
And her little hánd' lay lìghtly, confìdingly in míne;
But we'll meet no more at Bíngen—lòved Bíngen on the Rhìne!"

His voice' grew fáint and hoàrser; his grásp' was childish weàk;
His eyes put on a dying lóok; he síghed, and ceased to speàk.
Hís cómrade' bent to lìft him, but the spark of lífe had flèd,
The soldier of the Légion' in a foreign lánd was deàd!
And the soft móon' rose up slòwly, and càlmly she looked dówn!
On the red sand of the báttlefield, with bloody corpses strèwn;
Yéa' càlmly on that dreadful scéne' her pàle light' seemed to shíne,
As it shone on distant Bíngen—fair Bíngen on the Rhìne!

Hon. Mrs. Norton.

THE HEROIC SMITH.

[Richard Newton, an eminent divine, was born in Buckinghamshire in 1676, and died in 1753. He became the principal of Hart Hall in 1710, and was afterwards appointed to a canonry of Christ-church, Oxford. His works are, "University Education," "Pluralities Indefensible," "Sermons," &c.]

The following circumstance took place about twenty years ago at a village in Germany. One afternoon a great number of the villagers were assembled in the large room of the inn. There was only one door to the room, and that stood

open. The village Blacksmith—a good-natured, pious, brave-hearted man—sat near the door, talking pleasantly with some of his neighbours in the room.

All at once a large dog came and stood right in the doorway. He was a great powerful beast, with fierce, frightful look. His head hung down, his eyes were bloodshot, his great red tongue hung half out of his mouth, and his tail was dropped between his legs. As soon as the keeper of the inn saw him, he turned pale, and exclaimed, "Back, back! The dog is mad!" Then the women screamed, and there was great confusion in the room. There was no way out but by the door in which the dog stood, and no one could pass him without being bitten.

"Stand back, my friends," cried the brave smith, "till I seize the dog; then hurry out while I hold him. It is better that one should perish than all."

As he said this, he seized the foaming beast with an iron grasp, and dashed him on the floor. Then a terrible struggle followed. The dog bit furiously on every side in a most frightful manner. His long teeth tore the arms and thighs of the heroic smith, but he would not let go his hold. Unmindful of the great pain it caused, and the horrible death which he knew must follow, with the grasp of a giant he held down the snapping, biting, howling brute, till all his friends had escaped in safety. Then he flung the half-strangled beast from him against the wall, and dripping with blood and venomous foam, he left the room and locked the door. The dog was shot through the window, but what became of the brave but unfortunate smith?

The friends whose lives he had saved at the expense of his own, stood round him weeping. "Be quiet, my friends," he said, "do not weep for me, I have only done my duty. When I am dead, think of me with love; and now pray for me that God will not let me suffer long, or too much. I know I shall become mad, but I will take care that no harm comes to you through me."

He went to his shop, and took a strong chain, one end of which he rivetted with his own hands round his body, the

other end he fastened round the anvil so strongly that no earthly power could loose it. He then looked round on his friends and said, "Now it's done." You are all safe. I can't hurt you. Bring me food while I am well, and keep out of my reach when I am mad! The rest I leave with God."

Nothing could save the brave smith. Madness soon seized him, and he died after nine days of suffering. What a noble fellow! What a real hero that was!

DR. NEWTON.

THE ATMOSPHERE.

A PHILOSOPHER of the East, with a richness of imagery truly Oriental, describes the atmosphere as "a spherical shell which surrounds our planet to a depth which is unknown to us, by reason of its growing tenuity, as it is released from the pressure of its own superincumbent mass. Its upper surface cannot be nearer to us than fifty, and can scarcely be more remote than five hundred miles. It surrounds us on all sides, yet we see it not; it presses on us with a load of fifteen pounds on every square inch of surface of our bodies, or from seventy to one hundred tons on us in all, yet we do not so much as feel its weight. Softer than the softest down, more impalpable than the finest gossamer—it leaves the cobweb undisturbed, and scarcely stirs the lightest flower that feeds on the dew it supplies; yet it bears the fleets of nations on its wings around the world, and crushes the most refractory substances with its weight. When in motion, its force is sufficient to level the most stately forests and stable buildings with the earth—to raise the waters of the ocean into ridges like mountains, and dash the strongest ships to pieces like toys. It warms and cools by turns the earth and the living creatures that inhabit it. It draws up vapours from the sea and land, retains them dissolved in itself, or suspended in cisterns of clouds, and throws them down again as rain or dew when

they are required. It bends the rays of the sun from their path, to give us the twilight of evening and of dawn; it disperses and refracts their various tints to beautify the approach and the retreat of the orb of day. But for the atmosphere, sunshine would burst on us and fail us at once, and at once remove us from midnight darkness to the blaze of noon. We should have no twilight to soften and beautify the landscape; no clouds to shade us from the scorching heat, but the bald earth, as it revolved on its axis, would turn its tanned and weakened front to the full and unmitigated rays of the lord of day. It affords the gas which vivifies and warms our frames, and receives into itself that which has been polluted by use, and is thrown off as noxious. It feeds the flame of life exactly as it does that of the fire—it is in both cases consumed, and affords the food of consumption; in both cases it becomes combined with charcoal, which requires it for combustion, and is removed by it when this is over."

"It is only the girdling encircling air," says another philosopher, "that flows above and around all, that makes the whole world kin. The carbonic acid with which to-day our breathing fills the air, to-morrow seeks its way round the world. The date-trees that grow round the falls of the Nile will drink it in by their leaves; the cedars of Lebanon will take of it to add to their stature; the cocoa-nuts of Tahiti will grow rapidly upon it; and the palms and bananas of Japan will change it into flowers. The oxygen we are breathing was eliminated for us some short time ago by the magnolias of the Susquehanna, and the great trees that skirt the Orinoco and the Amazon—the giant rhododendrons of the Himalayas contributed to it, and the roses and myrtles of Cashmere, the cinnamon tree of Ceylon, and the forest older than the flood, buried deep in the heart of Africa, far behind the mountains of the moon. The rain we see descending was thawed for us out of the icebergs which have watched the polar star for ages; and the lotus lilies have sucked up from the Nile, and exhaled as vapour, snows that rested on the summit of the Alps."

"The atmosphere," continues Maun, "which forms the outer surface of the habitable world, is a vast reservoir, into which the supply of food designed for living creatures is thrown; or, in one word, it is itself the food, in its simple form, of all living creatures. The animal grinds down the fibre and the tissue of the plant, or the nutritious store that has been laid up within its cells, and converts these into the substance of which its own organs are composed. The plant acquires the organs and nutritious store thus yielded up as food to the animal, from the invulnerable air surrounding it.

"But animals are furnished with the means of locomotion and of seizure—they can approach their food, and lay hold of and swallow it; plants must wait till their food comes to them. No solid particles find access to their frames; the restless ambient air which rushes past them loaded with the carbon, the hydrogen, the oxygen, the water—everything they need in the shape of supplies—is constantly at hand to minister to their wants; not only to afford them food in due season, but in the shape and fashion in which alone it can avail them."

There is no employment more ennobling to man and his intellect than to trace the evidences of design and purpose in the Creator, which are visible in many parts of the creation. Hence to the right-minded mariner, and to him who studies the physical relations of earth, sea, and air, the atmosphere is something more than a shoreless ocean, at the bottom of which he creeps along. It is an envelope or covering for the dispersion of light and heat over the surface of the earth; it is a sewer, into which, with every breath we draw, we cast vast quantities of dead animal matter; it is a laboratory for purification, in which that matter is recompounded, and wrought again into wholesome and healthful shapes; it is a machine for pumping up all the rivers from the sea, and conveying the waters from their fountains on the ocean to their sources in the mountains; it is an inexhaustible magazine, marvellously adapted for many benign and beneficent purposes. MAURY.

SELECTIONS FROM SHAKSPEARE.

[WILLIAM SHAKSPEARE, the most illustrious dramatic poet of England, was born at Stratford-upon-Avon in 1564. His education was confined to a short course at the grammar school of his native place. Little is recorded of the early life of Shakspeare, but it appears that he was wild and irregular, and that his youthful imprudence drove him to London for shelter. There he became proprietor and manager of the Globe Theatre, and soon realized a handsome fortune, which enabled him to spend the close of his life in the vicinity of his native town, where he had bought a house and an estate, and where he died in 1616. Besides his immortal plays, he was the author of two poems—"Venus and Adonis," and "Lucrece." Of the lofty genius of Shakspeare, it has well been said, "We ne'er shall look upon his like again."]

INDISCRETION.

OUR indiscretion sometimes serves us well,
When our deep plots do fail; and that should teach us
There's a divinity that shapes our ends,
Rough-hew them how we will.

DANGER OF DELAY.

THERE is a tide in the affairs of men,
Which, taken at the flood, leads on to fortune;
Omitted, all the voyage of their life
Is bound in shallows and in miseries.

GOOD NAME.

GOOD name in man and woman,
Is the immediate jewel of their souls:
Who steals my purse, steals trash; 'tis something, nothing;
'Twas mine, 'tis his, and has been slave to thousands;
But he that filches from me my good name,
Robs me of that which not enriches him,
And makes me poor indeed.

MEN'S evil manners live in brass; their virtues
We write in water.

PROPER USE OF TALENTS.

Heaven doth with us, as we with torches do,
Not light them for themselves: for if our virtues

Did not go forth of us, 'twere all alike,
As if we had them not. Spirits are not finely touched,
But to fine issues; nor Nature never lends
The smallest scruple of her excellence,
But, like a thrifty goddess, she determines
Herself the glory of a creditor,
Both thanks and use.

MERCY.

The quality of mercy is not strained;
It droppeth as the gentle rain from heaven,
Upon the place beneath.—It is twice blessed;
It blesseth him that gives and him that takes.
'Tis mightiest in the mightiest; it becomes
The throned monarch better than his crown.
His sceptre shows the force of temporal power,
The attribute to awe and majesty,
Wherein doth sit the dread and fear of kings;
But mercy is above this sceptred sway;
It is enthroned in the hearts of kings;
It is an attribute to God himself;
And earthly power doth then show likest God's
When mercy seasons justice.

MIND THE TEST OF MAN.

'Tis the mind that makes the body rich:
And as the sun breaks through the darkest clouds,
So honour peereth in the meanest habit.
What! is the jay more precious than the lark,
Because his feathers are more beautiful?
Or is the adder better than the eel,
Because his painted skin contents the eye?
O, no, good Kate; neither art thou the worse
For this poor furniture and mean array.

SHAKSPEARE.

PLANTS, AND HOW THEY GROW.

Acrogenous, (*acros*, *gennao*, G.) growing at the top.
Assimilate, (*ad*, *similis*, L.) to convert into a like substance. Hence also *assimilation*.
Cell, (*cella*, L.) a small bag or cavity. Hence *cellular*, composed of cells.
Cotyledon, (*cotyledon*, G.) a seed-lobe. Hence also, *acotyledonous*, *monocotyledonous*, (*monos*, G.) and *dicotyledonous*, (*dis*, G.)
Elaborate, (*e*, *labor*, L.) to refine or improve by successive operations. Hence also *laboratory*, a place where such operations are carried on (usually a place for *chemical* experiments).
Elimination, (*e*, *limen*, L.) throwing off or setting free.
Embryo, (*embryon*, G.) the first rudiments of something not yet developed.
Endogenous, (*endon*, *gennao*, G.) growing inwards.
Equilibrium, (*æquus*, *libra*, L.) equal balance; just or suitable proportion.
Exogenous, (*exo*, *gennao*, G.) growing outwards.
Germ, (*germen*, L.) that from which a thing springs. Hence *germinate* (to sprout), *germination*, *germinative*.
Plumule, (*plumula*, L.)
Radicle, (*radicula*, *radix*, L.)
Spongiole, (*spongia*, L., G., also Eng *sponge*.)
Spore, (*Spora*, G.) Hence also *sporule*.

IMPORTANCE OF PLANTS.

Plants, or vegetables, form the connecting link between the animal and mineral kingdoms. We cannot, generally speaking, feed on minerals, though strange stories are told of certain savage tribes that sometimes eat clay, and we ourselves season our food with salt. But plants draw nourishment from the inorganic constituents of the soil in which they grow, and, by a wonderful process of assimilation, transform that nourishment into their own substance. It is then, in many cases, fit for the support of men and other animals. To plants we are also indebted for much of our clothing, for many valuable medicines, and for a great variety of other useful articles, which are applied to purposes innumerable.

In no part of his works has the Creator shown his goodness more conspicuously than in the vegetable kingdom. He has not only made bountiful provision for our wants, but taken pains to gratify and charm us. The greenness of the grass, the splendid colouring of flowers, the graceful forms of trees, and all the varied beauty of a summer landscape, are wholly unnecessary for the accomplishment of the main purposes which plants were intended to serve. But they are added for our enjoyment, to show us that our Maker wishes us to be happy. The faculty of discerning and appreciating beauty is his gift, and he has not left us with-

out ample scope for its exercise. It is well, then, that we should study the vegetable creation with those sentiments of gratitude which a bounty so generous ought always to inspire.

Figures cannot express, nor imagination conceive, the immense number of individual plants with which the earth is clothed. Even of distinct species, there are known at present upwards of 120,000, and there is little doubt that many more will yet be discovered. They exhibit the most wonderful diversity of size and form. The mould which gathers on decaying bodies consists of vegetables too small to be individually distinguished by the naked eye; while some of the largest forest trees rise to the height of 200 feet, and the banyan covers so vast an area, that a considerable army may repose under its shade.

Plants perform a very important function in purifying the atmosphere. Into this reservoir there is constantly poured immense quantities of carbonic acid gas, produced by the burning of fire, and the breathing of animals. By these same processes oxygen is consumed, so that the air, were there no means of compensation, would soon become deficient in oxygen, and overcharged with carbonic acid. This is, in fact, what usually happens in a close, ill-ventilated room, in which people are crowded, or fires kept burning. The effects of such a vitiation of the whole atmosphere would be most disastrous. Oxygen is essential to the maintenance of life; and in proportion as the necessary supply of this substance in the atmosphere is diminished, the vital functions of animals go on languidly, and their existence becomes comfortless. Apart altogether from the noxious qualities of the carbonic acid which would take its place, the mere abstraction of the oxygen of the air would soon be followed by the death of every living thing. Now all these consequences are averted by the influence of vegetable respiration. The leaves of plants inhale carbonic acid from the air, decompose it, and appropriate the carbon, letting the oxygen of the acid go free. Thus a perfect equilibrium is maintained among the constituents of the

atmosphere. It is observable, however, that for this respiratory action, plants require sunlight. In the dark the elimination of oxygen ceases, and it is said (though some are of a different opinion) that a small quantity of carbonic acid is evolved. Be this as it may, there can be no reasonable doubt that we have here a constant circulation of benefits between the two great provinces of organized nature. The plant purifies the air which the animal has poisoned, and by the same process extracts from it its own carbonaceous food.

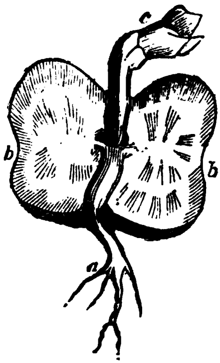
GERMINATION.

Every one has seen the little seed cast into the ground, and watched with eagerness the first appearance of the tender blade, which gradually developed into plant and flower. If we examine of what such a seed consists, we shall find that it contains, in most cases, provision for two grand purposes; first, for the safety of the *germ* or *embryo*, and, secondly, for the temporary support of the future plant. The germ, delicate and brittle beyond all other substances, is folded up within one or two leaves or lobes, called *cotyledons*. Either included in these, or immediately surrounding them, is a supply of nutritious matter to feed the little organism till it is able to draw nourishment from the earth in sufficient quantity for its demands.

When the seed is put into the ground, and there exposed to the influence of heat, air, and moisture, this dead nutritious matter begins to undergo certain chemical changes, whereby further heat is produced, and the living embryo soon puts forth its vital energy. From one part of it, called the *radicle*, a little rootlet, *a* (Fig. 6), pushes down into the soil; and another part, known as the *plumule*, sends out the sprout, *c*, which by and by appears above ground, and becomes gradually larger and larger, till it attains the dimensions and form of a full grown plant. The cotyledons, *b b*, also sometimes rise above ground, and, assuming a

green colour, perform the functions of leaves, till the ordinary leaves are developed; this is well seen in the lupin and turnip. In other cases, as in the bean and pea, they remain buried in the soil, the nourishment they contain being gradually absorbed, until they shrivel up, and finally disappear. In the same way the nutritive matter which surrounds the cotyledons is also absorbed.

FIG. 6.



Those plants which have seeds with two cotyledons are called *dicotyledonous*. They form by far the most numerous class, including all our ordinary timber trees, and an immense number of smaller plants. The seeds of others have but one cotyledon, which may usually be seen wrapped round the little plant in the earlier stages of its growth. These are called *monocotyledonous*. To this class belong the grasses, including all the varieties of grain, so valuable to man as the staple portion of his vegetable food. Among trees, it is represented by the palm, and other natives of tropical regions. There is still another class of plants, which have no seeds properly so called, but are propagated by minute cellular bodies called *spores* or *sporules*. Among these are ferns, mosses, lichens, and sea-weed. Spores have no cotyledons, and hence the plants of this third class are called *acotyledonous*.

The phenomena of germination are essentially the same, though different in detail, in all these classes. Both seed and spore contain the rudiments of the plants which are to spring from them, both are alike endowed with a principle of vitality, and, in the case of both, that principle will lie dormant, unless circumstances favour its development. If we keep a seed without moisture, or bury it so deep in the

earth that air shall find no access to it, the little germ, whether it live or die, can never send forth sprouts. Heat is also necessary to its activity, but the temperature which different seeds require is far from uniform. Light, on the other hand, retards germination; hence seeds are sown at a moderate depth below the surface of the soil, that they may have the benefit of darkness, without being excluded from the action of the air.

It is remarkable how long some of the harder seeds may retain their vitality. The germinative powers, when not stimulated into action by the circumstances in which the seed is placed, remain unimpaired for years, and sometimes even for centuries, ready to awaken into life at the first opportunity.

NUTRITIVE ORGANS OF PLANTS.

When the little plant has consumed the nourishment stored up for it in the seed, it becomes dependent on such food as it is able to extract from the surrounding earth and air. For the purpose of gathering thence the materials suitable for its support, converting them into an available form, and finally assimilating them to its own substance, it is endowed with three separate sets of organs,—the *root*, *b b* (Fig. 7), the *stem*, *c*, and the *leaves*, *d d*. The external appearance of these is so various, and, in their more usual forms, so well known, that a description is at once difficult and unnecessary. It may be well, however, to notice some less obvious, but extremely interesting particulars regarding them.

The *root* serves the double purpose of fixing the plant firmly in its place, and collecting nourishment from the soil. Its fibres accordingly shoot out in every direction, insinuating themselves, without injury, between stones and other obstacles, or winding round them till a less resisting medium is reached. If nourishment is not readily found

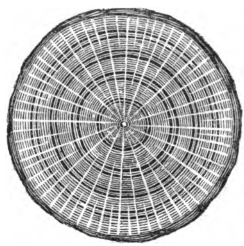
near the base of the stem, they extend themselves in whatever direction they receive most encouragement. Sometimes, on meeting with reservoirs of water, as in wells or drains, they spread and multiply with amazing rapidity. The extremities of the fibres are soft and porous, and are therefore called *spongioles*, *a a* (Fig. 7). These, like so many little mouths, absorb liquid matter from the soil, and convey it upwards to the stem, from which, again, it passes to the leaves, there to undergo the elaborating processes, by means of which it is to become suitable nourishment for the plant. Hence it appears that no substance can be taken up by the roots of plants, except in a state of solution. This is an important fact to the farmer, whose endeavour it is to replenish the exhausted soil, by means of manures, with that nutriment which the growth of crops has extracted from it. For it is clear that he must either supply the nutritious substances themselves in a soluble state, or some chemical agent which will act on the insoluble ingredients of the soil, and render them fit for the support of vegetable life.

Fig. 7.

The *stems* of plants are not always apparent; sometimes they are concealed underground, sometimes disguised in an

extraordinary form. They are distinguished from roots by the production of leaf-buds. Some are slender, and creep along the ground, as in strawberries. On the other hand, the bulbs of the onion and lily are reckoned stems; and even the potato, whose leaf-buds are familiarly called *eyes*, belongs rather to the stem than to the root. It is, in fact, a kind of subterranean branch. Stems are divided, according to their mode of growth, into three classes, corresponding exactly to the three classes of plants which are determined by the structure of the seed. In our forest trees, and all those plants already described as dicotyledonous, the stem increases *outwards*, a new layer of woody matter being deposited every year immediately below the bark. When the trunk of a tree is sawn across, these layers are distinctly visible, and by their number the age of the tree can be exactly ascertained. Such stems are called *exogenous*. The stems of monocotyledonous plants, on the other hand, increase *inwardly*, and are therefore called *endogenous*. In their case, the oldest and hardest part of the stem is the outside; they have no separable bark, and, generally speaking, no branches. Similar to them in these last respects are the stems of acotyledonous plants, which, altering little in thickness after being once formed, and increasing chiefly by additions to the summit, have received the name of *acrogenous*.

FIG. 8.



The *leaves* of plants play a very important part in carrying out the process of nutrition. Like the stem, they are of various forms, and (what is remarkable enough) a classification of plants according to these forms would nearly coincide with the two coincident classifications already referred to. In most exogenous plants, the ribs and veins of the leaves cross each other, so as to form a sort of net-

work, while in endogenous plants the veins are more or less parallel, and a variety of this latter form is characteristic of acrogenous plants. Leaves, as well as roots, are provided with little mouths; not, however, at their extremities merely, but over their whole surface. By means of these they extract nourishment from the air, and also exhale moisture, sometimes in such quantities as to affect the climate of a country. Hence the destruction of a forest not unfrequently makes a climate drier than it was before. The value of leaves in purifying the atmosphere, by the absorption and decomposition of carbonic acid gas, has been already noticed. But there is still another function of great importance which these organs perform. The fluids imbibed by the roots are conveyed through the stem to the leaves, in whose living laboratory, acting under the stimulating influence of air and light, they are transformed into those organic compounds on which the plant feeds. Thus prepared, they are then distributed over every part of the organism.

How can we sufficiently admire the wisdom which has endowed a structure apparently so simple, and withal so beautiful, with powers as various and wonderful as they are essential to the welfare of the plant! We examine the organs, and we see the result of their action, but who can tell the real nature of those processes by which the ends of their existence are attained? It was an empty boast of the proud naturalist, which he ordered to be inscribed on his statue—"A genius equal to the majesty of nature;" for it has been well remarked, that a single blade of grass was sufficient to confound his pretensions.

QUESTIONS FOR EXAMINATION.

In what respects are plants useful to man? What purpose is served by their beauty? What lesson should we learn from it? How many species of plants are known? What effect does the breathing of animals produce on the surrounding air? How is this effect counteracted? What would happen if it were not counteracted? Of what parts do seeds usually consist? What is the use of the cotyledons, and what becomes of them as the plant grows? From which part of the seed does the root of the plant proceed? Which part sprouts upwards? Explain the words *dicotyledonous*, *monocotyledonous*, and *acotyledonous*, with examples. Name some plants which are propagated by spores.

What is the influence on germination of moisture? of air? of heat? of light? What are the organs of nutrition in plants? What are the uses of the root? How does it accomodate itself to the soil? Which parts of it imbibe nourishment? In what form must such nourishment be? What is the use of manure? Give examples of peculiarly shaped stems. Classify stems according to their mode of growth. What kind of leaves usually grow on exogenous stems? on endogenous stems? What is the effect of leaves on climate? What purposes do they serve in nourishing the plant?

EXCHANGE.

In the earlier stages of society, exchanges were effected by direct giving and taking of commodity for commodity, or, as it is termed, *barter;* but great and serious difficulties attended this system, difficulties ever more deeply felt as exchanges multiply and become more various: the baker may not want the shoemaker's shoes, if the latter want his bread; but the latter may not want as much bread as equals the value of a pair of shoes, and payment by a half or a third of a pair of shoes is impossible. A medium of exchange, accordingly, is introduced; usually, the *precious* metals. Exchange, thus facilitated by the adoption of a medium which all are ready to receive, and by which most minute proportions of value may be easily represented, proceeds with vastly increased rapidity.

Exchanges becoming thus continually more frequent and complicated, it is found convenient and advantageous, on the principle of the division of labour, that a class of men should devote themselves to conduct the business of exchange solely, the work of production being left to others. By the introduction of *merchants,* who do not themselves produce, a greater amount of production is attained, on the whole, than would be possible if all both produced and exchanged without their intervention.

But for facility and frequency of exchange, even at home, rapidity, and ease, and safety of communication are indispensable; good roads, swift conveyances, canals, and ultimately railways arise, with their adjuncts of carriers and couriers, and post-establishments, and telegraphs of even greater ingenuity and efficiency.

Exchange, which was at first confined within the limits of one country, soon extends to other countries, with an immense advantage to all, for all are thus made partakers in the productions of each, which are more and more diverse according to the diversity of climate. Foreign commerce, with all that it involves of ships, docks, and warehouses, is the most powerful stimulus to home industry. But exchange, whether at home or abroad, is in all cases simply each man's giving something that he wants less, for something else that he wants more.

As geographical knowledge and means of transit are increased, numbers pass from one country to another; from countries densely peopled to those less so—from countries where land is all appropriated, to those where it is still unclaimed—from countries where capital and labour are comparatively unproductive, to those where both are more amply rewarded; new fields being thus perpetually opened up for human industry, and increased enjoyment provided by fresh and ever augmenting interchange, both for those who go and for those who stay.

But long ere this stage of progress has been reached, the precious metals themselves have been found incompetent to discharge the full duty of exchange; and paper money, or duly vouched promises to pay money, is introduced with a still more complicated machinery of bank-notes and bills of exchange, for the management of which class of transactions a still further division of labour is introduced by means of bankers, bill-brokers, and the other agents by whom, what we comprehensively call *credit* is carried on.

But life and property are subject to contingencies which involve serious loss, and which it is impossible always to prevent. It is discovered that the evil results to individuals, which would be ruinous to one, may, by combination, be distributed over many. Hence insurances against fire, against death, against disaster at sea, against hail storms, and diseases among cattle, against railway accidents, and even against fraud on the part of clerks and other assistants, all of which are based on calculation of averages, this again

being based on the conviction that a certain regularity prevails among events even the most anomalous and irregular. And thus, step by step, by a strictly natural course, does the work of industrial progress go on, till we witness its gigantic results in our own time, and in our own land.

Dr. Hodgson.

THE BROKEN HEART.

Every one must recollect the tragical story of young Émmet the Irish pàtriot; it was too toúching| to be soon forgòtten. During the troubles in Íreland, he was trìed, condèmned, and éxecuted, on a charge of treàson. His fáte| made a deep impréssion on public sỳmpathy. He was so yoùng—so intèlligent—so génerous—so bràve—so èverything that we are apt to líke in a young màn. His conduct under tríal, too, was so lófty and intrèpid. The noble indignation| with which he repelled the charge of treason against his coùntry, the eloquent vindication of his nàme, and his pathetic appeal to posterity, in the hopeless hour of condemnátion—àll thése| entered deeply into every generous bòsom, and even his ènemies lamented the stern pólicy| that dictated his execution.

But there was óne heart| whose ánguish it would be impòssible to describe. In happier dàys and fairer fórtunes, he had won the affections of a beautiful and interesting gírl, the dáughter of a late celebrated Irish bàrrister. She lóved him| with the disinterested férvour of a woman's fírst and eàrly love. When every worldly maxim arrayed itself agaínst him, when he was blasted in fòrtune, and when disgrace and danger darkened around his náme, she loved him the more árdently| for his very sùfferings. If, then, his fate could awaken the sympathy even of his fòes, what must have been the agony of hér| whose whole soùl was occupied by his image! Let thòse téll| who have had the portals of the tomb suddenly closed betwéen them| and the béing| they most lóved on eàrth—who have sat at its thréshold, as one

shut out in a cold and lonely wórld, from whence àll that was most lovely and lóving' had depàrted.

But then the hòrrors of such a gráve! so fríghtful, so dishònoured! There was nothing for memory to dwéll on' that could soothe the pang of separàtion—none of those tènder though melancholy circumstánces' that endéar the parting scène—nothing to melt sorrow into those blessed téars' sent, like the dews of heáven, to revive the heárt' in the parching hour of ànguish.

To render her widowed situation more désolate, she had incúrred her father's displeàsure by her unfortunate attáchment, and was an éxile from the paternal roòf. But could the sympathy and kind offices of friends' have reached a spirit so shocked and driven in by hórror, she would have expérienced no want of consolàtion, for the Irish' are a people of quíck and generous sensibìlities. The most delicate and cherishing atténtions' were paid her by fámilies of wealth and distìnction. She was led into socìety, and they tried by all kinds of occupation and amúsement' to dissipate her gríef, and wéan her' from the tragical story of her lòver. But it was áll in vàin. There are sóme strokes of calamity' that scáthe and scòrch the soul—that penetrate to the vital seat of háppiness—and blást it, never again to put forth bud or blòssom. She never objected to frequent the haunts of pléasure, but she was as much alóne there' as in the depths of sòlitude. She walked about in a sad réverie, apparently uncónscious of the world aroùnd her. She cárried with her' an inward wòe' that mocked at all the blandishments of friéndship, and "heeded not the song of the chármer, charm he éver so wìsely."

The person who told me her stóry' had seén her at a masqueràde. There can be no exhibition of far-gone wretchedness more striking and páinful' than to méet it' in such a scène. To find it wandering like a spectre, lonely and jóyless, where all around is gày—to see it dressed out in the trappings of mìrth, and looking so wàn and woé-begone, as if it had tried in vain to cheat the poor héart' into a momentary forgetfulness of sòrrow. After strolling through the

splendid rooms and giddy cròwd| with an air of utter abstráction, she sat herself down on the steps of an orchèstra, and looking about for some time with a vàcant air, that showed her insensibility to the garish scéne, she began with the capriciousness of a sickly heárt| to warble a little plaintive aìr. She had an exquisite voìce; but on thís occasion| it was so sìmple, so toùching, it breathed forth such a soul of wrétchedness, that she drew a cròwd| mute and silent aroúnd her, and melted évery one into teàrs.

The story of òne so true and ténder| could not but excite great ínterest| in a coúntry remarkable for enthùsiasm. It completely won the heart of a brave ófficer, who paid his addrèsses to her, and thought| that one so true to the déad| coùld not but prove afféctionate to the lìving. She declined his attèntions, for her thoughts were irrevocably engróssed| by the memory of her fòrmer lover. Hé, however, persìsted in his suit. He solicited not her ténderness, but her esteèm. He was assisted by her conviction of his wórth, and her sense of her own destitute and dependent situàtion, for she was exísting on the kindness of friènds. In a wòrd, he at length succeeded in gaining her hánd, though with the solemn assúrance| that her heárt was unalterably anòther's.

He took her with him to Sicily, hoping that a change of scéne| might wear out the remembrance of early woès. She was an amiable and exemplary wífe, and made an éffort to be a hàppy one; but nothing could cure the silent and devouring mélancholy| that had entered into her very sòul. She wasted away in a slów, but hopeless declìne, and at length sunk into the gráve, the víctim of a broken heàrt.

It was on hèr that Moore, the distinguished Irish póet, composed the following lìnes:—

"Shē is fār frōm the lānd| whēre her yoūng hēro sleéps,
And lovers| around her are síghing;
But coldly she turns from their gaze| and wéeps,
For her heárt in his gràve is lying.

She sings the wild songs of her dear native pláins,
Every note which hè loved| awáking—
Ah! little they think, who delight in her stráins,
How the heart of the mìnstrel is breaking!

He had lived for his lóve—for his coúntry he died,
They were all that to life had entwined him—
Nor soon shall the tears of his country be dríed,
Nor lóng will his lóve stay behind him.

Oh! māke hĕr a grāve whēre the sūn-beāms rést
When they prómise a glorious mòrrow;
They'll shine o'er her sleep, like a smile from the wést,
From her own loved island of sorrow!"

WASHINGTON IRVING.

THE CHRISTIAN PAUPER'S DEATHBED.

[CAROLINE BOWLES, or MRS. SOUTHEY, was born near Lymington in 1787, and died in 1854. Her earliest production was the "Birthday." But for more than twenty years, the writings of Caroline Bowles were altogether anonymous, and although widely circulated and warmly appreciated by the public, it was not until after the publication of "Ellen Fitz Arthur" and her "Chapters on Churchyards," which first appeared in Blackwood's Magazine, that her name and identity became known beyond a very limited circle. On the death of the poet Southey's first wife, she accepted him as her husband in 1839.]

Tread sòftly—bow the hèad—
In reverent silence bow—
No passing bell doth tóll,
Yét an immortal sòul
Is pássing nòw.

Strànge! however gréat,
With lowly rèverence bow;
There's òne in that poor shéd—
O'ne by that paltry bèd—
Gréater than thòu.

Beneath that beggar's róof,
Ló! deàth doth keep his state,
E'nter—no cròwds attend—
E'nter—no guàrds defénd
This palace gate.

Thāt pāvement, dāmp and cōld,
No smiling coùrtiers tread;
One sílent wòman stands,
Lifting with meagre hánds
A dying hèad.

No mingling vóices sound—
  An infant wàil alone;
A sob supprèssed—agaìn
That short! deep! gasp, and thén—
  The parting gròan.

Òh! chánge—óh, wòndrous change!
  Bùrst are the prison bárs—
This móment! *thère*, so lów,
So àgonized—and nów!
  Beyond the stàrs.

Òh! chánge—stupèndous change!
  Thére! lies! the soulless clòd;
The sun etèrnal breaks—
The new immórtal! wàkes—
  Wákes! with his Gòd.

CAROLINE SOUTHEY.

THE GULF STREAM.

THERE is a river in the ocean. In the severest droughts it never fails, and in the mightiest floods it never overflows. Its banks and its bottom are of cold water, while its current is of warm. The Gulf of Mexico is its fountain, and its mouth is in the Arctic Seas. It is the Gulf Stream. There is in the world no other such majestic flow of waters. Its current is more rapid than the Mississippi or the Amazon, and its volume more than a thousand times greater.

The currents of the ocean are among the most important of its movements. They carry on a constant interchange between the waters of the poles and those of the equator, and thus diminish the extremes of heat and cold in every zone.

The sea has its climates as well as the land. They both change with the latitude; but one varies with the elevation above, the other with the depression below the sea level.

The climates in each are regulated by circulation; but the regulators are, on the one hand, winds; on the other, currents.

The inhabitants of the ocean are as much the creatures of climate as are those of the dry land; for the same Almighty hand which decked the lily, and cares for the sparrow, fashioned also the pearl, and feeds the great whale, and adapted each to the physical conditions by which his providence has surrounded it. Whether of the land or the sea, the inhabitants are all his creatures, subjects of his laws, and agents in his economy. The sea, therefore, we may safely infer, has its offices and duties to perform; so, may we infer, have its currents; and so, too, its inhabitants: consequently, he who undertakes to study its phenomena, must cease to regard it as a waste of waters. He must look upon it as a part of that exquisite machinery by which the harmonies of nature are preserved, and then he will begin to perceive the developments of order and the evidences of design.

From the Arctic Seas a cold current flows along the coasts of America, to replace the warm water sent through the Gulf Stream, to moderate the cold of western and northern Europe. Perhaps the best indication as to these cold currents may be derived from the fishes of the sea. The whales first pointed out the existence of the Gulf Stream, by avoiding its warm waters. Along the coasts of the United States all those delicate animals and marine productions which delight in warmer waters are wanting, thus indicating, by their absence, the cold current from the north now known to exist there.

In the genial warmth of the sea about the Bermudas on one hand, and Africa on the other, we find in great abundance those delicate shell-fish and coral formations which are altogether wanting in the same latitudes along the shores of South Carolina.

No part of the world affords a more difficult or dangerous navigation than the approaches of the northern coasts of the United States in winter. Before the warmth of the Gulf

Stream was known, a voyage at this season from Europe to New England, New York, and even to the Capes of the Delaware or Chesapeake, was many times more trying, difficult, and dangerous than it now is. In making this part of the coast, vessels are frequently met by snow storms and gales which mock the seaman's strength, and set at naught his skill. In a little while his bark becomes a mass of ice; with her crew frosted and helpless, she remains obedient only to her helm, and is kept away for the Gulf Stream. After a few hours' run she reaches its edge, and almost at the next bound passes from the midst of winter into a sea at summer heat. Now the ice disappears from her apparel, and the sailor bathes his stiffened limbs in tepid waters. Feeling himself invigorated and refreshed with the genial warmth about him, he realizes out there at sea the fable of Antæus and his mother Earth. He rises up and attempts to make his port again, and is again, perhaps, as rudely met and beat back again from the north-west; but each time that he is driven off from the contest, he comes forth from this stream, like the ancient son of Neptune, stronger and stronger, until, after many days, his freshened strength prevails, and he at last triumphs and enters his haven in safety, though in this contest he sometimes falls to rise no more.

The ocean currents are partly the result of the immense evaporation which takes place in the tropical regions, where the sea greatly exceeds the land in extent. The enormous quantity of water there carried off by evaporation disturbs the equilibrium of the seas; but this is restored by a perpetual flow of water from the poles.

When these streams of cold water leave the poles they flow directly toward the equator; but, before proceeding far, their motion is deflected by the diurnal motion of the earth. "At the poles they have no rotatory motion, and although they gain it more and more in their progress to the equator, which revolves at the rate of a thousand miles an hour, they arrive at the tropics before they have gained the same velocity of rotation with the intertropical ocean. On that

account they are left behind, and, consequently, flow in a direction contrary to the diurnal rotation of the earth. Hence the whole surface of the ocean for thirty degrees on each side of the equator flows in a stream or current three thousand miles broad from east to west. The trade winds, which constantly blow in one direction, combine to give this great equatorial current a mean velocity of ten or eleven miles in twenty-four hours."

Were it not for the land, such would be the uniform and constant flow of the waters of the ocean. The presence of the land interrupts the regularity of this great western movement of the waters, sending them to the north or south according to its conformation.

The principal branch of the equatorial current of the Atlantic takes a north-westerly direction from off Cape St. Roque, in South America. It rushes along the coast of Brazil, and, after passing through the Caribbean Sea, and sweeping round the Gulf of Mexico, it flows between Florida and Cuba, and enters the North Atlantic under the name of the Gulf Stream, the most beautiful of all the oceanic currents.

In the Strait of Florida the Gulf Stream is thirty-two miles wide, two thousand two hundred feet deep, and flows at the rate of four miles an hour. Its waters are of the purest ultra-marine blue as far as the coasts of Carolina; and so completely are they separated from the sea through which they flow, that a ship may be seen at times half in the one and half in the other.

As a rule, the hottest water of the Gulf Stream is at or near the surface; and as the deep-sea thermometer is sent down, it shows that these waters, though still much warmer than the water on either side at corresponding depths, gradually become less and less warm, until the bottom of the current is reached. There is reason to believe that the warm waters of the Gulf Stream are nowhere permitted, in the oceanic economy, to touch the bottom of the sea. There is everywhere a cushion of cool water between them and the solid parts of the earth's crust. This arrangement is

suggestive, and strikingly beautiful. One of the benign offices of the Gulf Stream is to convey heat from the Gulf of Mexico—where otherwise it would become excessive—and to dispense it in regions beyond the Atlantic, for the amelioration of the climates of the British Islands and of all Western Europe.

Now, cold water is one of the best non-conductors of heat, but if the warm water of the Gulf Stream were sent across the Atlantic in contact with the solid crust of the earth, comparatively a good conductor of heat, instead of being sent across, as it is, in contact with a non-conducting cushion of cool water to fend it from the bottom, all its heat would be lost in the first part of the way, and the soft climates of both France and England would be as that of Labrador, severe in the extreme, and ice-bound.

It has been estimated that the quantity of heat discharged over the Atlantic from the waters of the Gulf Stream, in a winter's day, would be sufficient to raise the whole column of atmosphere that rests upon France and the British Islands from the freezing point to summer heat.

Every west wind that blows across the stream on its way to Europe, carries with it a portion of this heat to temper there the northern winds of winter. It is the influence of this stream that makes Erin the "Emerald Isle of the Sea," and that clothes the shores of Albion in evergreen robes; while, in the same latitude, the coasts of Labrador are fast bound in fetters of ice.

As the Gulf Stream proceeds on its course, it gradually increases in width. It flows along the coast of North America to Newfoundland, where it turns to the east, one branch setting towards the British Islands, and away to the coasts of Norway and the Arctic Ocean. Another branch reaches the Azores, from which it bends round to the south, and, after running along the African coast, it rejoins the great equatorial flow, leaving a vast space of nearly motionless water between the Azores, the Canaries, and Cape de Verd Islands. This great area is the Grassy or Sargasso Sea, covering a space many times larger than the British

Islands. It is so thickly matted over with gulf weeds that the speed of vessels passing through it is often much retarded. When the companions of Columbus saw it, they thought it marked the limits of navigation, and became alarmed. To the eye, at a little distance, it seems substantial enough to walk upon. Patches of the weed are always to be seen floating along the outer edge of the Gulf Stream. Now, if bits of cork or chaff, or any floating substance, be put into a basin, and a circular motion be given to the water, all the light substances will be found crowding together near the centre of the pool, where there is the least motion. Just such a basin is the Atlantic Ocean to the Gulf Stream; and the Sargasso Sea is the centre of the whirl.

Columbus first found this weedy sea, in his voyage of discovery: there it has remained to this day, moving up and down, and changing its position according to the seasons, the storms, and the winds.

Exact observations as to its limits and their range, extending back for fifty years, assure us that its mean position has not been altered since that time.

MAURY.

THE OCEAN.

[LORD GEORGE BYRON was born in London in 1788. His father was Captain John Byron, and his mother Miss Gordon of Gight, an Aberdeenshire heiress, whom Captain Byron had married solely for her fortune. Through the licentious conduct of her profligate husband, Mrs. Byron's fortune having been greatly narrowed, she was compelled to retire with her infant son to Aberdeen, and young George was placed in the grammar school of that city, where he received the rudiments of his education. The poet has immortalized his affectionate recollections of his early life in Scotland in "Lochnagar," and the verses of "Auld Lang Syne" in "Don Juan." In 1798 he succeeded to the family title and estates, and was sent by his guardian, Lord Carlisle, to Harrow, and thence to Cambridge in 1804, where he became chiefly remarkable for his eccentric habits and his defiance of the rules of discipline. On quitting Cambridge he soon after published his "Hours of Idleness;" the severe criticism of which, in the "Edinburgh Review," elicited the first specimen of the noble poet's real powers in the satire "English Bards and Scotch Reviewers." Restless and misanthropic, Lord Byron now resolved to make a tour on the continent, from which he returned in 1811, but soon set out again on a similar excursion. The insurrection of the Greeks having broken out in 1821, he resolved to devote his

fortune, his pen, and his sword to their cause. He caught a fever in consequence of his exertions, and died at Missolonghi in 1824. The poetic genius of Lord Byron was capable of soaring to the sublime, but sometimes descended to a reckless profligacy. A few of his leading works are "Childe Harold," "The Bride of Abydos," "Lara," "Hebrew Melodies," "Don Juan," &c.]

THERE is a pléasure| in the pathless wòòds;
There is a rápture| on the lonely shòre;
There is socìety| where none intrúdes,
By the deep séa, and músic in its roàr:
I love not màn the léss, but náture mòre,
From thése our ìnterviews; in which I steal
From all I mày be, or háve been before,
To mingle with the ùniverse, and feel
What I can ne'er expréss, yet cannot all concèal.

Rōll ōn, thōu dēep| and dārk-blūe ōcean—ròll!
Ten thousand fléets| sweep óver thee| in vàin;
Man| marks the éarth with ruin—his contról|
Stops with thy shòre; upon the watery plain,
The wrecks are all thý deed, nor doth remain
A shàdow of mán's ravage, save his òwn,
When, for a mòment, like a drop of raín,
He sinks into thy depths| with bubbling gróan,
Without a gràve, unknèlled, uncóffined, and unknòwn.

Hìs steps| are not upon thy páths—thy fields|
Are not a spoil for hím—thou dost aríse
And shake him fròm thee; the vile strength| he wields
For eárth's destruction| thóu| dost all despìse,
Spùrning him from thy bósom to the skiès,
And send'st him, shivering| in thy playful spráy,
And howling, to his gòds, where haply lies
His petty hope| in some near port or báy,
And dashest him agàin to earth—thère let him lay.

The armaments| which thunder-strike the walls
Of rock-built cíties, bidding nations quàke,
And monarchs| tremble| in their cápitals—
The oak levìathans, whose hūge rībs| māke
Their clāy creātor| the vāin tītle tāke|

Of lord of thee, and arbiter of wár:
Thése' are thy tòys, and, as the snowy fláke,
They mélt into thy yeast of wàves, which mar
Alike the Armada's príde, or spóils of Tràfalgar.

Thy shóres' are èmpires, changed in áll' save thèe—
Assýria, Greèce, Ròme, Cárthage, whát are thèy?
Thy waters' wasted them' while they were frée,
And many a týrant sìnce; their shores obey
The stránger, sláve, or sàvage; their decáy'
Has dried up reálms to dèserts:—not so thóu,
Unchàngeable' save to thy wild waves' pláy—
Tíme' writes no wrìnkle' on thine azure brów—
Such as creation's dáwn beheld, thou rollest nòw!

Thōu glōrious mìrror, where the Almighty's fórm'
Glàsses itself in témpests!—in àll time—
Cálm or convùlsed, in brèeze, or gàle, or stórm,
Icìng the póle, or in the tórrid clime'
Dark-heàving—boùndless, éndless, and sublìme!
The image of Etèrnity!—the thróne
Of the Invìsible!—Even from out thy slìme'
The mònsters of the deep' are made! Each zòne'
Obéys thee! Thou goest fòrth, dreàd! fáthomless! alòne!

BYRON.

PLANTS, AND HOW THEY MULTIPLY.

Anther, (*antheros*, *anthos*, G.)
Apex, (*apex*, L.) the tip or point.
Calyx, (*calyx*, L. and G.)
Corolla, (*corolla*, *corona*, L.)
Cryptogamic, (*cryptos*, *gamos*, G.) concealing reproduction.
Cuticle, (*cutis*, L.) skin or outer covering.
Fecundate, (*fœcundus*, L.) to make fruitful.
Filament, (*filamenta*, *filum*, L.)
Ovary, (*ovum*, L.) the case which contains the *ovule*. Hence also *ovule*, the undeveloped seed.
Petal, (*petalon*, G.) a flower-leaf.
Phanerogamic, (*phaneros*, *gamos*, G.) showing reproduction.
Pistil, (*pistillum*, L.)
Pollen, (*pollen*, *pollis*, L.)
Sepal, (*sepio*, L.)
Stamen, (*sto*, L.)
Stigma, (L. and G.)
Style, (*stylus*, L., *stylos*, G.)
Tunicle, (*tunica*, L.) a natural covering.
Viscid, (*viscidus*, *viscus*, L.) clammy, sticky, adhesive, tenacious. (Also *viscous*).
Whorl, (from the same root as E. *whirl* and *warble*) a ring or circle of leaves arranged round a common centre.

REPRODUCTIVE ORGANS OF PLANTS.

Every organized body, whether animal or vegetable, is the subject of perpetual change. We have seen how plants spring from seed, and how their subsequent development is provided for by those organs which collect, prepare, and assimilate their food. But these processes will not go on for ever. There comes an inevitable period of decay, when the vital powers will languish, and ultimately cease. Thus the world would soon become a dead and doleful waste, were it not that the principle of life is from time to time renewed. The individual dies, but the race does not perish. In addition, then, to the wonderful mechanism by which vegetable life is supported, we have to consider the still more remarkable functions by whose operation it is reproduced and multiplied.

In those plants which are propagated by means of seeds, whether dicotyledonous or monocotyledonous, the organs of reproduction are all included in the flower or blossom, which gradually ripens into fruit. The fruit, when fully matured, either is, or contains the seed. But acotyledonous plants are entirely destitute both of flowers and fruit. Instead of seeds, they have those seed-like bodies called *spores* or *sporules*, produced from the living plant by means of certain obscure organs, whose nature and mode of action are not well understood. In many cases it is difficult even to ascertain what are the organs by which this function is performed. That there must be, in every species, the faculty of reproduction, cannot be reasonably doubted; but it seems often impossible to determine how it operates, or even in what part of the plant it resides. All plants may therefore be divided, according to the nature of their reproductive organs, into two great classes, *flowerless* and *flowering*, or, in the language of botanists, *cryptogamic* and *phanerogamic*. Phanerogamic plants are by far the most numerous and important.

The flowers of different species present the greatest variety of external form, but they are all, in structure, more

or less analogous to each other. They grow from the stalk or axis of the plant, very much in the same way as ordinary leaves, of which, indeed, all their parts may be regarded as so many different modifications. The arrangement of these parts will be best understood by referring to the accompanying illustrations. Fig. 10 shows the external coverings. In fig. 9 these are removed, so as to exhibit the internal,

FIG. 9. FIG. 10.

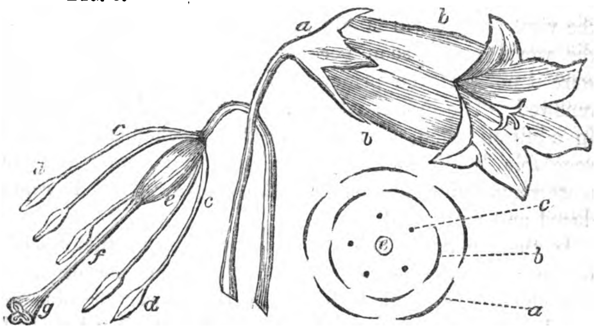


FIG. 11.

and, as we shall see, more essential organs. A cross section of the whole flower is represented in fig. 11. The outermost covering is the *calyx* (*a*), consisting of a circle or *whorl* of more or less modified leaves, in which, as in a cup, the rest of the flower is inserted. The calyx is generally, but not always, green. Different from it in this respect is the next whorl, called the *corolla* (*b*). It is the ornamental part of the flower, and is in most cases gaily coloured. At first, it is wrapped up in the calyx, but gradually expands and overtops it, becoming, in its turn, a protective covering to the internal organs. These are the *stamens* (*c d*) and *pistil* (*e f g*), which are directly concerned in the production of the seed, and must therefore be present in every fertile flower, whereas the calyx and corolla are frequently wanting. The stamens form one or more whorls, surrounding the pistil, which occupies the centre; and, when there are more pistils than one, they too are arranged in whorls. It is

worthy of remark that the parts of each whorl are usually found to occupy alternate positions with those of the next, as seen in fig. 11. Thus the *petals,* or leafy organs which compose the corolla, are disposed alternately with those of the calyx, which are called *sepals.* It follows that, in the same flower, the number of petals and of sepals will in general be the same. Similarly, the petals are alternate with the outermost whorl (if there be more than one) of stamens, these with the next whorl, and so on; so that the stamens will either be equal in number to the petals, or some multiple of them. In monocotyledonous plants, the number of parts in each whorl is very often three; while two, four, and five are more frequent in those which are dicotyledonous.

Such is a general description of the flower; the respective functions of its different parts must form the subject of another lesson.

REPRODUCTIVE ORGANS OF PLANTS—CONTINUED.

The functions of the calyx and corolla are nutritive as well as protective. Both are intended to minister to the wants of the interior organs, which, as the direct instruments of reproduction, it is the end and aim of the whole organism to mature. The sepals of the calyx, like ordinary leaves, absorb carbonaceous food from the atmosphere; while the corolla is chiefly concerned in the production of coloured juices, and of a nutritious sugary substance which serves important purposes in the economy of the plant. When these functions are no longer necessary, the petals usually wither and fall, but the calyx often remains in connection with the fruit. It may be seen adhering to gooseberries and currants, round the point to which the stalk is attached.

A stamen generally consists of two parts, the *filament* (*c*) * and the *anther* (*d*), of which the latter only is essential. The filament is, as its name implies, a thread-like organ, at-

* See fig. 9, page 104.

them to the light and air; after which they have, in many cases, by the very form of the full-blown flower, the light and heat reflected upon them from the concave surface of the corolla. Many flowers have also the singular faculty of closing, or *going to sleep*, when night sets in, and opening again in the morning. Others open only by night, and at mid-day are completely closed. There is, indeed, scarcely any hour of the day, at which these phenomena are not going on with more or less intensity. We can easily see the object of this wonderful sensibility. It is simply that the petals may so dispose themselves as to shelter the tender interior organs, opening or closing as this purpose renders either change of position requisite.

Such are a few of the precautions taken to secure the safe development of the organs on which the production of the seed depends. If we now look at the seed itself, we shall find that no less care is bestowed on its preservation. As the flower decays, the whole energies of the plant are devoted to the nursing of the little embryo which it has left behind. Gradually the embryo and its enclosing ovary increase in bulk, assuming, in different plants, an incalculable variety of forms, all of which evidently conduce to the security of the seed. The results of this process are seen in the endless diversity of fruits. Sometimes, as in cherries and other stone fruits, the seed is enclosed in a strong shell, which is itself surrounded by a pulp; sometimes, again, as in grapes, oranges, and berries, it is plunged over-head in a glutinous syrup, contained in a skin or bladder; at other times, as in apples and pears, it is embedded in the heart of a firm fleshy covering; or, as in strawberries, pricked into the surface of a soft pulp. These and many other varieties occur in what are popularly called fruits. But, if we take into account the matured seed-vessels of grasses, herbs, trees, and all other seed-bearing plants, which are also fruits in the strict botanical sense, the number of different forms to be met with is altogether incomputable. Plants of the pea tribe have their seeds regularly disposed in pods, which exclude the wet even in the heaviest

rains; and these pods are sometimes lined with a soft down, as in the bean, or distended, as in senna, like a blown bladder. A woolly substance envelopes the seeds of the cotton plant, while those of the thistle and artichoke are barricaded with spikes and prickles. In the grasses we find the seeds enclosed in hard shells or tunicles, with which they are so intimately connected as to be inseparable.

As soon as the seeds, whose safety is so carefully provided for, have been matured, the next business is to disperse them. They cannot serve the purposes for which they are designed while they remain wrapt up in their several coverings. Accordingly, some fruits, whenever the seeds within them are fully ripe, burst open in various ways so as to scatter them; while others fall to the ground without opening, and their seeds are liberated by the decay of the surrounding substance. Various agencies then contribute to their dispersion. Streams often convey to a distance the seeds of plants that grow on their banks. Winds are available for the same purpose, and hence many seeds, such as those of the thistle and dandelion, are endowed with appendages not improperly called wings. By means of these they are enabled to float in the air, and it is no uncommon thing, in a windy day, to see them far away from the parent plant. Some pulpy fruits are picked up by birds, and the little seeds they contain, being hard and indigestible, are soon deposited again in a state quite fit for germination. And, last of all, the seeds of plants valuable as food have been dispersed by man over such parts of the globe as are suited for their cultivation.

Thus we have arrived at the point from which we started in our sketch of the growth and functions of plants. From the seed are developed root, and stem, and leaves, by which the plant is nourished and increased. Then comes the flower, filling the air with perfume, and clothing the earth with beauty. But these are not the main objects of its existence. It exhausts itself in perfecting the seed; and this seed, again committed to the earth, gives birth, in its turn, to new plants and flowers, similar to that from which

it sprung. And so on, from generation to generation, and from age to age, the wheel of vegetable life incessantly revolves—a small, but beautiful and essential part of the stupendous machinery of nature.

QUESTIONS FOR EXAMINATION.

Why is reproduction necessary in the vegetable kingdom? Which part of the plant contains the organs of reproduction? What are *cryptogamic* plants? *phanerogamic* plants? What classes formerly spoken of are included in this last? What is the outer covering of the flower called? What are the different parts of this covering called? What part of the flower is in general beautifully coloured? Of what use is it? What are petals? stamens? whorls? What relation subsists between the number of petals and that of stamens? How are the parts of successive whorls arranged? What part of the flower occupies the centre? Which is the essential part of the stamen? With what is it filled? What is the use of pollen? Describe the different parts of the pistil. How is the pollen conveyed to the stigma? How does it obtain communication with the ovule? What is the effect of this communication on the ovule? on the rest of the flower? Why do some plants produce so much pollen? How do bees convey the pollen to its destination? Show how the seed-producing organs of plants are protected and cared for. What is meant by plants "going to sleep?" Why do they so? How are the seeds of different plants protected till they reach maturity? Give examples. How are they then dispersed? Give examples.

GOD IN NATURE.

There lives and works
A soul in all things, and that soul is God.
The beauties of the wilderness are His,
That make so gay the solitary place,
Where no eye sees them. And the fairer forms,
That cultivation glories in, are His.
He sets the bright procession on its way,
And marshals all the order of the year;
He marks the bounds which Winter may not pass,
And blunts his pointed fury; in its case,
Russet and rude, folds up the tender germ,
Uninjured, with inimitable art;
And, ere one flowery season fades and dies,
Designs the blooming wonders of the next.

COWPER.

SECTION III.

CHARACTERISTICS OF SCOTLAND.

[**Part of the Address of Sir David Brewster at the Opening of Edinburgh University, 4th November, 1863.**]

There are fèw countries| that possess objects and institutions of a more varied ínterest| than our òwn. Dístant enough from the frigid zòne, indénted by sinuous èstuaries, and spacious bays and deep inlets of the ócean, Scótland| enjoys a clímate| mild and salùbrious, equally remòved from the rigours of an artic wínter| and the scorching héats of a tropical sùn. No exhalàtions poison its átmosphere, no sirócco blìghts it, and we know no more of the tornado and the éarthquake| than what makes us gràteful for our ignorance. At àll seasons| Scótland is accessible to the strànger—whether he comes as a pìlgrim with his staff and his scríp, or is welcomed to its shóres| by the light béacons that guard them by nìght. Ráilroads| carry him along its sèaboard, over its mountain cháins, and through its picturesque vàlleys; and the busy stéamer| plies uncéasingly| along its wínding and rugged còasts. With this extérnal character| the intérior of our peninsula correspònds. Mountain ránges of lofty àspects—hére| rising into peaks of grànite, thère| descending into precipices of gneiss, or running into pillars of basált—embosom lákes of the purest and most limpid wàter, or give birth, in their córries, to the elements of the càtaract, whích, at a lòwer level, rushes over its prècipíces, and to the sources of the mighty ríver| which adorns and fértilises the region of industry and lìfe. In descending to the level of vegetable fórms, we enter upon scénery| at once picturésque and beaùtiful—hère| clothed with sober héath, thére| gay with the richest vèrdure—at òne place, the crevice of the róck pushing out its crumped and wild vegetátion, and at anóther, the river bànk| displaying its embróidery of birch and òak, while the flanks of the eternal híll's| retire into purple shàdow, invested with the folds of the glóomy and the stately pìne. Amidst scenes like thése, the géologist

and the àntiquary| will discover features of nature and works of árt| which no óther country has yet exhìbited.

I do not refér| to our lavas of grànite, nor to the gems and óres which they embòsom, nor to our buried fòrests, with their decaying roots of the fourth and fifth generátion; nor to our basaltic caves and gigantic sea-clíffs| lashed by the òcean. Nor do I refer to our ancient càstles, guarding our mountain pásses, or frowning from our hèadlands; nor to the plains and fástnesses| where Róman ambìtion was chécked and English dominátion repèlled; but I refér| to one of the most magnìficent formátions of the antediluvian àge—the parallel róads of Glenròy, which baffle the sagácity of the geòlogist; and also to those extraordinary works of mán—the vitrified fórts in the Hìghlands, above thirty in númber, which equally perplex the antiquáry and the àrchitect. In òur sober latitude, and in a lánd| neither teeming with wealth nor familiar with lúxury, a strànger will not find any of those excíting amusements| which he may have witnessed in rícher countries| and among an ìdler people. We cànnot offer him| either the bull-fight or the càrnival, and he must rècross the Twéed| to enjoy in perfèction the excitement of the túrf, or shúdder| at the brutality of the prìze-ring; but, what he may value móre, we can show him our héath and our rìver sports, where the genius of mán| strives with the sagacity of ìnstinct, and where animal life is sácrificed| less for amúsement than for ùse. We can shòw him| the games and cóntests of our northern clàns; the schools of héroes, ever réady at the call of their coùntry—lóyal even to wòrthless sovereigns, and fáithful even in a dòubtful cause. To the stranger of gráver mood| Scotland presents objects of contemplátion| of equal interest and impòrtance. In her institutions for relìgious and sécular education| will be found arrángements| to admíre and to ìmitate; and in the reaction of knòwledge| upon the character and habits of her péople, the phìlosopher may discover new lines of stúdy, and the státesman new principles of gòvernment. In our chùrches and schóols| they will find the machínery| by which a virtuous populátion has been rèared; and in the simplicity of

our wórship' they may learn the prócess by which faith appeals to the jùdgment more than to the imaginàtion, and becomes a continuous principle of dúty, instead of a series of ímpulses' efficácious' only during the high préssure which prodùces them. Hére, therefore, the stránger' will find no gorgeous tèmples — none of the pomp and cìrcumstance which decorates the fóreign churches, and in the sòrcery of which' the pénitent leans on the broken reed of the priést, and enhances his formal aspirátions' by the supplement of pious frauds and lying mìracles; but unpreténding as are our tèmples and sìmple our rítes, we are not without assoaiátions' which influence the imaginátion' and reach the heàrt. Our cìvil and relígious liberties' were won togèther. With the swórd in òne hand and the trùth in the óther' our fáthers resisted unto dèath' the énemies of their fàith, and the fiélds on which they triumphed or fèll, and the séa-beach and glèns where they wórshipped are stìll remémbered' with réverence and affèction.

THE OLD ARM CHAIR.

I love it—I love it, and who shall dare
To chide me for loving that old arm chair!
I've treasured it long as a sainted prize—
I've bedewed it with tears, and embalmed it with sighs;
'Tis bound by a thousand bands to my heart,
Not a tie will break, not a link will start.
Would you learn the spell? a mother sat there!
And a sacred thing is that old arm chair.

In childhood's hour I lingered near
The hallowed seat with listening ear;
And gentle words that mother would give,
To fit me to die, and teach me to live.
She told me shame would never betide,
With truth for my creed, and God for my guide;
She taught me to lisp my earliest prayer,
As I knelt beside that old arm chair.

I sat and watched her many a day,
When her eyes grew dim and her locks were grey,
And I almost worshipped her when she smiled
And turned from her Bible to bless her child.
Years rolled on, but the last one sped—
My idol was shattered—my earth star fled:
I learnt how much the heart can bear,
When I saw her die in that old arm chair.

'Tis past! 'tis past! but I gaze on it now
With quivering breath and throbbing brow:
'Twas there she nursed me—'twas there she died,
And memory flows with lava tide—
Say it is folly, and deem me weak,
While the scalding tears start from my cheek.
But I love it—I love it, and cannot tear
My soul from a mother's old arm chair.

ELIZA COOK.

LORD CHATHAM ON THE AMERICAN WAR.

[WILLIAM PITT, Earl of Chatham, one of the most illustrious statesmen that ever graced the British senate, was the son of Robert Pitt, Esq., of Boconock, in Cornwall, where he was born in 1708. Having been returned as a member of parliament, his great talents as an orator were soon displayed in opposition to Sir Robert Walpole. After holding some of the chief offices in the cabinet, and as he was speaking with his accustomed eloquence and energy against the American war, in the House of Lords, April 7, 1778, he fell down in a convulsive fit, and died in a few weeks after.]

I CANNOT, my lords, I wìll not, join in congratulátionꜝ on misfórtune and disgràce. Thís, my lords, is a périlousꜝ and tremèndous moment. It is not a tíme for adulàtion: the smoothness of fláttery꜠ cannot sáve usꜝ in this rúgged and awful crìsis. It is now necessary to instruct the thróneꜝ in the language of trùth. We must, if póssible, dispèl the delusion and darkness which envélop it, and displáy, in its full dànger and genuine cólours, the rúinꜝ which is brought to our doòrs. Can ministersꜝ stíll presume to expect support in their infatuation? Can párliamentꜝ be so dèad to

its dignity and dúty, as to give their support to méasures| thus obtrùded| and fórced upon them? Méasures, my lords, which have reduced this late flourishing émpire| to scórn and contèmpt! "But yésterday, and Britain| might have stood against the wòrld; nów| none so póor| as to do her rèverence." The pèople whom we at fírst despised as rèbels, but whom we nòw acknowledge as énemies, are abètted against us, supplíed| with every military stòre, have their interest consùlted, and their ambassadors entertáined, by our inveterate ènemy—and mínisters| dó not, and dàre not, interpóse with dignity or effèct. The desperate state of our army abróad| is in part knòwn. Nò man| more highly estéems| and hònours the British troops| than I' do; I` know their virtues and their válour; I knów| they can achieve ànything but impossibílities; and I knów| that the conquest of British Amérìca| is an impossibility. You cànnot, my lords, you cànnot conquer America. What is your present situàtion there? We do not know the wórst, but we knòw| that in three campáigns| we have done nóthing, and suffered mùch. You may swell every expènse, accumulate every assìstance, and extend your traffic| to the shambles of every German déspot, your attémpts| will be for ever váin and ìmpotent—doùbly so, indeed, from this mercenary áid on which you relỳ; for it írritates, to an incùrable resentment, the minds of your advérsaries, to overrún them| with the mercenary sons of rapine and plùnder, devoting thèm| and their posséssions| to the rapácity of hìreling cruelty. If I| were an Amèrican, as I am an E'nglishman, while a foreign tròop| was landed in my coúntry, I nèver would lay down my arms—nèver—néver—nèver!

Bùt, my lords, whò is the man| that, in addìtion to the disgraces and mischiefs of the wár, has dàred to authorise| and associate to our árms| the tòmahawk and scálping-knife of the sàvage? to call into civilized allíance| the wild and inhuman inhábitant of the wòods? to délegate| to the merciless I'ndian| the defence of disputed ríghts, and to wage the horrors of his barbarous wár| against our brèthren? My lórds, thése enormities| cry aloud for redress and pùnish-

ment. Bút, my lords, this barbarous measure has been defénded| not only on the principles of policy and necéssity, but álso on those of moràlity, "for it is perfectly allòwable," says Lord Suffolk, "to use all the méans| which Gòd and náture| have put into our hànds." I am astònished, I am shòcked, to hear such prínciples confèssed; to hear them avowed in this hóuse, or in this coùntry. My lórds, I did not intend to encroach so mùch on your attention, but I cànnot repress my indignation—I féel myself| impèlled to speak. My lórds, we are cálled upon| as members of this hòuse, as mén, as Chrìstians, to protèst against such horrible barbarity! "That Gòd and náture| have put into our hands!" Whàt ideas of God and nature that noble lord may entertáin| I knòw not, but I knòw| that such detèstable prínciples| are equally abhórrent to religion and humànity. Whát! to attribute the sacred sanction of God and náture| to the massacres of the Indian scálping-knife! to the cannibal sávage, tòrturing, mùrdering, devóuring, drínking the blòod of his mangled víctims! Súch notions| shock every precept of moràlity, every feeling of humánity, every sentiment of hònour. These abominable prìnciples, and this mòre abominable avówal of them, demánd the most decìsive indignation.

I call upon that right rèverend, and this most learned bénch, to vìndicate the religion of their Gód, to support the jústice of their coùntry. I call upon the bíshops| to interpose the unsullied sanctity of their làwn, upon the júdges| to interpose the purity of their èrmine, to sáve us from this pollùtion. I call upon the honour of your lórdships| to rèverence the dignity of your áncestors, and to maintáin your òwn. I call upon the spirit| and humanity of my coúntry| to vindicate the national chàracter. I invòke the génius of the constitùtion. I solemnly call upon your lòrdships, and upon èvery order of men in the státe, to stàmp upon this infamous procédure| the indelible stígma of the public abhòrrence. My lórds, I am óld and wèak, and at présent unable to say mòre, but my feelings and indignátion| were too stróng to have said lèss. I could not have slept

this night in my bèd, nor even reposed my head upon my píllow, without giving vént! to my etérnal abhòrrence of such enórmous! and prepòsterous principles.

EDINBURGH AFTER FLODDEN.

NEWS of battle!—news of battle!
  Hark! 'tis ringing down the street:
And the archways and the pavement
  Bear the clang of hurrying feet.
News of battle! who hath brought it?
  News of triumph? Who should bring
Tidings from our noble army,
  Greetings from our gallant king?

All last night we watched the beacons
  Blazing on the hills afar,
Each one bearing, as it kindled,
  Message of the opened war.
All night long the northern streamers
  Shot across the trembling sky:
Fearful lights, that never beacon
  Save when kings or heroes die.

News of battle! who hath brought it?
  All are thronging to the gate;
"Warder—warder! open quickly!
  Man—is this a time to wait?"
And the heavy gates are opened;
  Then a murmur long and loud,
And a cry of fear and wonder
  Bursts from out the bending crowd.
For they see in battered harness
  Only one hard-stricken man;
And his weary steed is wounded,
  And his cheek is pale and wan;

Spearless hangs a bloody banner
  In his weak and drooping hand—
What! can that be Randolph Murray,
  Captain of the city band?

Round him crush the people, crying,
"Tell us all—oh, tell us true!
Where are they who went to battle,
  Randolph Murray, sworn to you?
Where are they, our brothers—children?
  Have they met the English foe?
Why art thou alone, unfollowed?
  Is it weal, or is it woe?"
Like a corpse the grisly warrior
  Looks from out his helm of steel;
But no word he speaks in answer—
  Only with his armed heel
Chides his weary steed, and onward
  Up the city streets they ride;
Fathers, sisters, mothers, children,
  Shrieking, praying by his side.
"By the Power that made thee, Randolph,
  Tell us what mischance hath come."
Then he lifts his riven banner,
  And the asker's voice is dumb.

The elders of the city
  Have met within their hall—
The men whom good King James had charged
  To watch the tower and wall.
"Your hands are weak with age," he said,
"Your hearts are stout and true;
So bide ye in the Maiden Town,
  While others fight for you.
My trumpet from the Border-side
  Shall send a blast so clear,
That all who wait within the gate
  That stirring sound may hear.

Or, if it be the will of heaven
  That back I never come,
And if, instead of Scottish shouts,
  Ye hear the English drum,—
Then let the warning bells ring out,
  Then gird you to the fray,
Then man the walls like burghers stout,
  And fight while fight you may.
'Twere better that in fiery flame
  The roof should thunder down,
Than that the foot of foreign foe
  Should trample in the town!"

Then in came Randolph Murray,—
  His step was slow and weak,
And, as he doffed his dinted helm,
  The tears ran down his cheek:
They fell upon his corslet,
  And on his mailed hand,
As he gazed around him wistfully,
  Leaning sorely on his brand.
And none who then beheld him
  But straight were smote with fear,
For a bolder and a sterner man
  Had never couched a spear.
They knew so sad a messenger
  Some ghastly news must bring,
And all of them were fathers,
  And their sons were with the king.

And up then rose the provost—
  A brave old man was he,
Of ancient name, and knightly fame,
  And chivalrous degree.

*   *   *   *   *

Oh, woeful now was the old man's look,
  And he spake right heavily—

"Now, Randolph, tell thy tidings,
However sharp they be!
Woe is written on thy visage,
Death is looking from thy face:
Speak! though it be of overthrow—
It cannot be disgrace!"

Right bitter was the agony
That wrung that soldier proud:
Thrice did he strive to answer,
And thrice he groaned aloud.
Then he gave the riven banner
To the old man's shaking hand,
Saying—"That is all I bring ye
From the bravest of the land!
Ay! ye may look upon it—
It was guarded well and long,
By your brothers and your children,
By the valiant and the strong.
One by one they fell around it,
As the archers laid them low,
Grimly dying, still unconquered,
With their faces to the foe.
Ay! ye well may look upon it—
There is more than honour there,
Else, be sure, I had not brought it
From the field of dark despair.
Never yet was royal banner
Steeped in such a costly dye;
It hath lain upon a bosom
Where no other shroud shall lie.
Sirs! I charge you, keep it holy,
Keep it as a sacred thing,
For the stain you see upon it
Was the life-blood of your king!"

Woe, woe, and lamentation!
What a piteous cry was there!

Widows, maidens, mothers, children,
  Shrieking, sobbing in despair!

* * * * *

"O the blackest day for Scotland
  That she ever knew before!
O our king! the good, the noble,
  Shall we see him never more?
Woe to us, and woe to Scotland!
  O our sons, our sons and men!
Surely some have 'scaped the Southron,
  Surely some will come again!"
Till the oak that fell last winter
  Shall uprear its shattered stem—
Wives and mothers of Dunedin—
  Ye may look in vain for them!

* * * * *

AYTOUN.

THE STORY OF WILLIAM WALLACE.

[WALTER SCOTT, the son of a writer to the Signet, was born in Edinburgh in 1771. After studying at the High School and the University of Edinburgh, he was trained to the legal profession, and passed as an advocate in 1792. He afterwards abandoned his profession, and resolved to make literature the basis of his fortune, when he witnessed the great popularity of his "Minstrelsy of the Scottish Border." He then published in rapid succession "The Lay of the Last Minstrel," "Marmion," "The Lady of the Lake," &c., when his poetical reputation reached its culminating point, as the rising poetical star of Lord Byron was now paling every other fire. Scott now commenced that series of novels which chiefly constitute his passport to fame. He died at Abbotsford in 1832. His novels are, "Waverley," "Tales of my Landlord," "Ivanhoe," "The Heart of Mid-Lothian, &c.]

WILLIAM WALLACE was none of the high nobles of Scotland, but the son of a private gentleman called Wallace of Ellerslie, in Renfrewshire. He was very tall and handsome, and one of the strongest and bravest men that ever lived. He had a very fine countenance, with a quantity of fair hair,

and was particularly dexterous in the use of all weapons which were then employed in battle. . . . Wallace, like all Scotsmen of high spirit, had looked with great indignation upon the usurpation of the crown by Edward, and upon the insolence which the English soldiers committed on his countrymen.

The action which occasioned his finally rising in arms happened in the town of Lanark. Wallace was at this time married to a lady of that place, and residing there with his wife. . . . It chanced, as he walked in the market-place, dressed in a green garment with a rich dagger by his side, that an Englishman came up and insulted him on account of his finery; saying, a Scotsman had no business to wear so gay a dress, or carry so handsome a weapon. . . . It soon came to a quarrel, and Wallace, having killed the Englishman, fled to his own house, which was speedily assaulted by all the English soldiers. The governor of Lanark, whose name was Hazelrigg, burned the house, and put his wife and servants to death. He also proclaimed Wallace an outlaw, and offered a reward to any one who should bring him to an English garrison alive or dead.

On the other hand, Wallace soon collected a body of men outlawed like himself. One of his earliest expeditions was directed against Hazelrigg, whom he killed. He fought skirmishes with the soldiers who were sent against him, and often defeated them; and in time became so well known and so formidable, that multitudes began to resort to his standard, until at length he was at the head of a considerable army, with which he proposed to restore his country to independence.

At length, an opportunity presented itself near Stirling to engage the English army under the Earl of Surrey: and the Scotch were victorious.

The remains of Surrey's great army fled out of Scotland after this defeat; and the Scots, taking arms on all sides, attacked the castles in which the English soldiers continued to shelter themselves, and took most of them by force or stratagem. Wallace defeated the English in

several combats, chased them out of Scotland, regained the towns and castles of which they had possessed themselves, and recovered for a time the complete freedom of the country.

Edward I. was in Flanders when all these events took place. You may suppose he was very angry when he heard that Scotland, which he thought completely subdued, had risen into a great insurrection against him, defeated his armies, killed his treasurer, and chased his soldiers out of their country. He came back from Flanders in a mighty rage, and determined not to leave that rebellious country until it was finally conquered, for which purpose he assembled a very fine army and marched into Scotland.

In the meantime the Scots prepared to defend themselves, and chose Wallace to be governor or protector of the kingdom, because they had no king at the time. He was now titled Sir William Wallace, Protector, or Governor of the Scottish nation. But, although, as we have seen, he was the best soldier and bravest man in Scotland, and therefore the most fit to be placed in command, at this critical period, when the King of England was coming against them with such great forces, yet the nobles of Scotland envied him this important situation, because he was not a man born in high rank, or enjoying a large estate. . . . So great was their jealousy of Sir William Wallace, that many of these great barons did not seem very willing to bring forward their forces, or to fight against the English. Yet, notwithstanding this unwillingness of the great nobility to support him, Wallace assembled a large army; for the middle, but especially the lower classes, were very much attached to him. . . . He marched boldly against the King of England, and met him near the town of Falkirk. Most of the Scottish army were on foot, because in those days only the nobility and great men of Scotland fought on horseback.

The English king, on the contrary, had a very large body of the finest cavalry in the world, Normans and English, all clothed in complete armour. He had also the celebrated archers of England, each of whom was said to carry twelve

Scotsman's lives under his girdle, because every archer had twelve arrows stuck in his belt.

The Scots had some good archers from the forest of Ettrick; but they were not nearly equal in number to the English. . . . The greater part of the Scotch, armed with long spears, were placed thick and close together, and laid all their spears so close, point over point, that it seemed as difficult to break through them as through the wall of a strong castle. When the two armies were drawn up facing each other, Wallace said to his soldiers, "I have brought you to the ring, let me see how you can dance."

The English made the attack. King Edward, though he saw the close ranks and undaunted appearance of the Scottish infantry, resolved nevertheless to try whether he could not ride them down with his cavalry. He therefore gave his horsemen orders to advance. . . . They charged accordingly at full gallop. It must have been a terrible thing to have seen these fine horses riding as hard as they could against the long lances which were held out by the Scots to keep them back, and a dreadful cry arose when they came against each other.

The Scottish spearmen being thrown into some degree of confusion by the loss of those who were slain by the arrows of the English, the heavy cavalry of Edward again charged with more success than formerly, and broke through the ranks, which were already disordered. . . . Sir John Graham, Wallace's great friend and companion, was slain, with many other brave soldiers; and the Scots, having lost a very great number of men, were at length obliged to take to flight.

After the fatal defeat of Falkirk, Sir William Wallace seems to have resigned his office of Governor of Scotland. The King of England obliged all his nobles and great men, one after another, to submit themselves once more to his yoke. . . . Wallace, alone, refused either to acknowledge the usurper Edward or to lay down his arms. He continued to maintain himself among the woods and mountains of his native country for no less than seven years after the battle

of Falkirk. . . . Many proclamations were sent out against him by the English, and a great reward was set upon his head. For the sake of this reward Wallace was basely betrayed by a pretended friend, and led prisoner to the Tower of London.

Edward caused this gallant defender of his country to be brought to trial in Westminster Hall before English judges. He was accused of having been a traitor to the English crown, to which he answered, "I could not be a traitor to Edward, for I was never his subject." . . . He was then charged with having taken and burnt towns and castles, with having killed many men, and done much violence. He replied, with the same calm resolution, "That it was true he had killed very many Englishmen, but it was because they had come to subdue and oppress his native country of Scotland, and far from repenting what he had done, he declared he was only sorry that he had not put to death many more of them."

Notwithstanding that Wallace's defence was a good one, both in law and in common sense (for surely every one has not only a right to fight in defence of his native country, but is bound in duty to do so), the English judges condemned him to be executed. . . . So this brave patriot was dragged upon a sledge to the place of execution, where his head was struck off and his body divided into four quarters, which, according to the cruel custom of the time, were exposed upon spikes of iron on London Bridge.

SCOTT.

CHRISTIAN PATRIOTS.

Patriots have toiled, and in their country's cause
Bled nobly; and their deeds, as they deserve,
Receive proud recompense. We give in charge
Their names to the sweet lyre. The historic muse,
Proud of the treasure, marches with it down

To latest times; and Sculpture, in her turn,
Gives bond in stone and ever-during brass
To guard them, and to immortalize her trust:
But fairer wreaths are due, though never paid,
To those who, posted at the shrine of Truth,
Have fallen in her defence. A patriot's blood,
Well spent in such a strife, may earn indeed,
And for a time ensure, to his loved land
The sweets of liberty and equal laws;
But martyrs struggle for a brighter prize,
And win it with more pain. Their blood is shed
In confirmation of the noblest claim—
Our claim to feed upon immortal truth,
To walk with God, to be divinely free,
To soar, and to anticipate the skies.
Yet few remember them. They lived unknown,
Till persecution dragg'd them into fame,
And chased them up to Heaven. Their ashes flew—
No marble tells us whither. With their names
No bard embalms and sanctifies his song:
And history, so warm on meaner themes,
Is cold on this. She execrates indeed
The tyranny that doomed them to the fire,
But gives the glorious sufferers little praise.

He is the freeman whom the truth makes free,
And all are slaves beside. There's not a chain
That hellish foes, confederate for his harm,
Can wind around him, but he casts it off
With as much ease as Samson his green withes.
He looks abroad into the varied field
Of nature, and, though poor perhaps compared
With those whose mansions glitter in his sight,
Calls the delightful scenery all his own.
His are the mountains, and the valleys his,
And the resplendent rivers. His to enjoy
With a propriety that none can feel,
But who, with filial confidence inspired,

Can lift to Heaven an unpresumptuous eye,
And smiling say—"My Father made them all!"

COWPER.

THE SWORD CHANT OF THORSTEIN RAUDI.*

[WILLIAM MOTHERWELL was born at Glasgow in 1798, and died in 1835. He was successively editor of the "Paisley Magazine," "Paisley Advertiser," and the "Glasgow Courier." Some of his poems possess a pathos and an intensity of feeling not often surpassed.]

'Tis not the grey hawk's flight o'er mountain and mere;
'Tis not the fleet hound's course tracking the deer;
'Tis not the light hoof-print of black steed or grey,
Though sweltering it gallop a long summer's day,
Which mete forth the lordships I challenge as mine;
    Ha! ha! 'tis the good brand
    I clutch in my strong hand,
That can their broad marches and numbers define.
    Land Giver! I kiss thee.

Dull builders of houses, base tillers of earth,
Gaping, ask me what lordships I owned at my birth;
But the pale fools wax mute when I point with my sword
East, west, north, and south, shouting, There am I lord!
Wold and waste, town and tower, hill, valley, and stream,
    Trembling, bow to my sway,
    In the fierce battle-fray,
When the star that rules Fate is this falchion's red gleam.
    Might Giver! I kiss thee.

I've heard great harps sounding in brave bower and hall,
I've drank the sweet music that bright lips let fall,
I've hunted in greenwood, and heard small birds sing;
But away with this idle and cold jargoning!

* Thorstein Raudi was one of the famous Norse pirates, or Sea-kings of former days.

The music I love is the shout of the brave,
    The yell of the dying,
    The scream of the flying,
When this arm wields Death's sickle, and garners the grave.
    Joy Giver! I kiss thee.

Far isles of the ocean thy lightning have known,
And wide o'er the mainland thy horrors have shone.
Great sword of my father, stern joy of his hand!
Thou hast carved his name deep on the stranger's red strand,
And won him the glory of undying song.
    Keen cleaver of gay crests,
    Sharp piercer of broad breasts,
Grim slayer of heroes, and scourge of the strong!
    Fame Giver! I kiss thee.

In a love more abiding than that the heart knows,
For maiden more lovely than summer's first rose,
My heart's knit to thine, and lives but for thee;
In dreamings of gladness, thou'rt dancing with me,
Brave measures of madness in some battle-field,
    Where armour is ringing,
    And noble blood springing,
And cloven, yawn helmet, stout hauberk, and shield.
    Death Giver! I kiss thee.

The smile of a maiden's eye soon may depart,
And light is the faith of fair woman's heart;
Changeful as light clouds, and wayward as wind,
Be the passions that govern weak woman's mind.
But thy metal's as true as its polish is bright;
    When ills wax in number,
    Thy love will not slumber,
But, star-like, burns fiercer, the darker the night.
    Heart Gladdener! I kiss thee.

My kindred have perished by war or by wave,—
Now, childless and sireless, I long for the grave.

When the path of our glory is shadowed in death,
With me thou wilt slumber below the brown heath;
Thou wilt rest on my bosom, and with it decay;
    While harps shall be ringing,
    And Scalds shall be singing
The deeds we have done in our old fearless day.
    Song Giver! I kiss thee.

MOTHERWELL.

THE ANIMAL KINGDOM.—INVERTEBRATA.

Abdomen, (L.) the lower part of the body, the belly.
Amœba, (*amoibē*, G.)
Anemone, (*anemōnē*, *anemos*, G.) wind flower.—*Sea-anemone*, a kind of polype.
Antenna, (L.)
Articulata, (*articulus*, *artus*, L.)
Chrysalis, (L.)
Convex lens, (*convexus*, *lens*, L.) a round piece of glass or other transparent substance, thicker in the middle than at the edges, thus, ...

Entomology, (*entoma*, *logos*, G.) The science that treats of insects. Hence also *entomologist*.
Genus, (L.) a kind or race.
Hydra, (*hydra*, *hydōr*, G.)
Ichneumon, (*ichneumōn*, *ichnos*, G.) a sort of minute insects that feed on the larger species.
Imago, (L.) *Lit. the image.*
Insect, (*insecta*, *in*, *seco*, L.)
Larva, (*larva*, L.) an insect in its embryo or first state.
Mammal, (*mamma*, L.)
Metamorphosis, (*meta*, *morphē*, G.) transformation, change of shape.
Mollusca, (*mollis*, L.)
Polype, (*polys*, *pous*, G.) a class of the *radiata*.
Proteus, a sea deity, who had the faculty of assuming different shapes.
Pupa, (*pupus*, *pupa*, L.)
Radiata, (*radius*, L.)
Tentacle, (*tentaculum*, *tento*, L.) a feeler.
Thorax, (L.) the chest, or middle part of the body.
Unicellular, (*unus*, *cella*, L.) consisting of one cell.
Vertebra, (*vertebra*, *verto*, L.) a bone of the spine. Hence *vertebrate*, *invertebrate*, *vertebrata*, *invertebrata*, *vertebral*.
Zoophyte, (*zoōn*, *phyton*, G.) an animal-plant.

VARIETY AND CLASSIFICATION OF ANIMALS.

IN whatever direction we turn our eyes, we everywhere meet with the varied forms of animal life. Earth, air, and water are all alike occupied by multitudes of living creatures, each specially fitted for the habitation assigned to it by nature. Every wood and meadow, nay, every tree, and shrub, and tuft of grass, has its inhabitants; even beneath the surface of the ground large numbers of the smaller animals find an abode suited to their tastes and habits. Myriads of birds sweep through the atmosphere, or solicit our attention by the songs which they pour forth from their

resting places; whilst swarms of insects, on lighter wings, dispute with them the empire of the air. The waters, whether salt or fresh, are also filled with living organisms; fishes, in innumerable shoals, mingling with a vast profusion of polypes, sponges, starfishes, crabs, oysters, and other creatures, whose forms are as singular as they are endlessly diversified. Nor are these phenomena confined to any one region of the earth; on the contrary, diversity of climate only adds to the variety of the objects which the zoologist has to contemplate.

It is, however, but a very limited portion of the animal kingdom that the naked eye is capable of perceiving. The microscope reveals to us countless millions of animalcules, spread everywhere around us, and even within our bodies, where they prey upon our substance or our food. Viewed through this instrument, every drop of water presents a busy scene of life and activity, and every flower a little world teeming with inhabitants. All these creatures are of course exceedingly minute, yet they are endowed with various organs, sometimes of the most singular description, by which they are enabled to perform the functions necessary for life and propagation. We are apt to regard them as insignificant, but we should remember that wonders are not the less wonderful for being packed into small compass; on the contrary, the very minuteness of these organisms is itself marvellous.

Even this does not exhaust the wide and interesting field of inquiry which zoology affords. Many thousands of species now extinct, are preserved as fossils in the rocky deposits of bygone ages, along with thousands more of those species which still exist. Such remains form no inconsiderable part of the whole crust of the earth.

Yet, in the midst of this astonishing variety, there is a uniformity scarcely less remarkable. Here, as in other portions of His works, it appears as if the Creator had proceeded on a general plan, modifying it more or less to suit the circumstances of each different species. For example, all the higher classes of animals have an internal skeleton,

including a skull and backbone; and the latter is never rigid, but consists of a number of bones jointed into each other, so as to admit of a certain degree of flexure. These bones are called *vertebrae*, and hence animals so constructed receive the general name of VERTEBRATA, or VERTEBRATE animals. None of these have more than four limbs, which take the form of legs, arms, wings, or fins, according to the necessities of the creatures to which they belong. Thus the general vertebrate type admits of great variety in details, and that variety forms the basis of further classification. Accordingly, the vertebrata are divided into *four* great classes—*mammals*, *birds*, *reptiles*, and *fishes*. The highest and most perfect in organization are the mammals, including (among many others) all the ordinary domestic animals, and man himself. These four classes are again subdivided into *orders*, orders into *families*, families into *genera*, and genera into *species*.

Of *invertebrate* animals, which have no backbone, there are usually reckoned three groups or divisions :—

I. MOLLUSCA (*pulpy animals*), comprising all those which have a soft, moist body, covered with a tough skin, and sometimes also with a shell, such as the snail, the cuttle-fish, and the oyster.

II. ARTICULATA (*jointed animals*), so called from their bodies being divided into rings or segments. To this division belong the innumerable hosts of insects, such as bees, butterflies, moths, gnats, beetles, crickets, and many others. It also includes spiders, crabs, lobsters, and worms.

III. RADIATA (*rayed animals*), whose most striking characteristic is, that all the parts of their bodies (at least in the well-defined species) are arranged like rays round a common central axis. The starfish, jelly-fish, and sea-anemone may be named as examples.

Each of these three groups is subdivided into orders, families, &c., exactly in the same way as the vertebrata. Thus a complete scheme of classification is formed, which is not only valuable as a systematic index to the animal creation, but is also intended to reflect and represent, so

far as man is able to comprehend it, the plan of the all-wise Creator.

THE HUMBLER FORMS OF ANIMAL LIFE.

MANY of the humbler animals bear so close a resemblance to vegetables, that they were long supposed to occupy a sort of intermediate position between the two great provinces of organised nature. Hence they have received the name of *zoophytes*, or animal-plants. They are now included among the *radiata*.

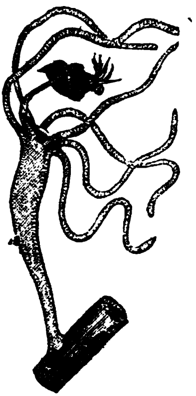
At the very lowest point of the animal kingdom, we meet with a series of creatures in which the functions of life are performed by a single cell and its contents. A good example is the *amœba*, a singular microscopic animalcule, often found at the bottom of fresh-water ponds. This remarkable creature has the power of shooting out from all parts of its body finger-like projections, which serve the purposes of legs or arms. These it speedily draws in again, and extemporises fresh ones in rapid succession as it moves along, thus continually changing its shape, so as to justify the name of Proteus originally bestowed upon it. It has neither mouth nor stomach, yet we must not suppose that it keeps a perpetual fast. On the contrary, it seems to be, in its small way, of an exceedingly voracious disposition. When it meets with anything suitable for its support, the substance of the creature grows, as it were, round its destined prey, till the latter is fairly enclosed, after which it is gradually absorbed. The same extraordinary habits are met with in other varieties of unicellular animals.

Considerably higher in the scale of animated being are those aquatic creatures generally known as *polypes*. All of these are zoophytes. Some of them inhabit the sea, as the *sea-anemones;* while others, as the *hydra,* are found in fresh water only.

The hydra consists of a long gelatinous cylinder, attached by one extremity to some aquatic plant (Fig. 12), and furnished at the other with very long tentacles, which it stretches about in the water in search of the minute

animals on which it feeds. It is remarkable for its voracity. Like many other zoophytes, the hydra is propagated by a process of budding or gemmation, the young animals growing out, branch-like, from the body of their parent. Strange as this may appear, there is a still more surprising artificial mode in which these creatures may be multiplied. If a living one be cut in pieces, it does not die, but each piece becomes a perfect animal. Portions cut off are speedily replaced, and wounds, however deep, heal up with marvellous rapidity. One of the most extraordinary facts connected with this creature is, that it may actually be turned inside out, like the finger of a glove, without any derangement of its functions; the inner and outer skin exchanging places, and adapting themselves, without difficulty, to the performance of each other's functions.

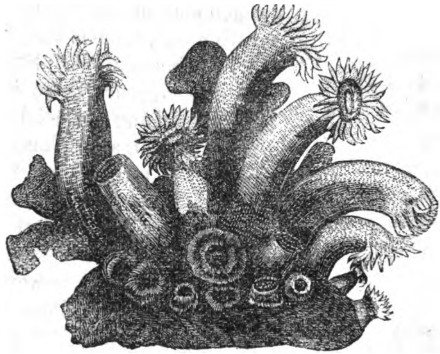
FIG. 12.—THE HYDRA.



The sea-anemone is in some respects similar to the hydra, but much more beautiful, and more complicated in its structure. It is most plentiful in tropical climates, but large numbers are also found on our own coasts, adhering to rocks and other submarine substances. Their tentacles (Fig. 13), being disposed in regular circles, and tinged with a variety of bright, lively colours, very nearly represent the petals of some of our most elegantly fringed and radiated flowers, such as the carnation, marigold, and anemone. It is from this resemblance that they derive their name. They are almost equal to the hydra in voracity, and in the power of surviving and repairing an amount of injury that would be fatal to most other animals. If the upper part of a sea-anemone's body be cut away, the base will produce a new mouth and tentacles, and proceed with its vital functions as

if nothing had happened. Nor is the part cut off less tenacious of life. On the contrary, a new base is gradually

Fig. 13.



developed, and in the meantime the tentacles are stretched out, and the mouth swallows its accustomed prey, apparently quite unconscious that it has no stomach to put it into! Yet this same creature, which seems so indestructible, may be killed in a few minutes by immersion in fresh water!

Such are a few specimens of the wonderful phenomena which the study of the humblest animals presents to us. Well may we say with the Psalmist, "O Lord, how manifold are thy works, in wisdom hast thou made them all."

INSECTS.

Insects are the highest, and by far the most numerous class of the *articulata.* Their study forms one of the most interesting portions of natural history, and is, indeed, often treated as a separate science, under the name of *entomology.*

Like other *articulata,* their bodies are composed of rings or segments, which are usually thirteen in number, one forming the *head,* three the *thorax,* and nine the *abdomen.*

The head is furnished with a curiously shaped mouth, two *antennæ*, or feelers, and two large eyes of the most wonderful construction. These eyes are almost always of the kind called compound; they are composed of an immense number (sometimes as many as 20,000) of small convex lenses, each of which is supposed to be a distinct and effective eye. The thorax bears the organs of motion, which, in most insects, consist of six legs and four wings. Some species, however, such as the common fly and the gnat, have but two wings; and others, as fleas and bugs, are entirely destitute of these appendages.

Small as insects generally are, they play an important part in the economy of nature. They are the general scavengers both of the earth and atmosphere. Whenever the dead body of an animal is exposed, thousands of them assemble and bury it in their voracious stomachs. The filth and fetid matter which would otherwise poison all the springs of life, by filling the air with pestilential effluvia, supply to them the means of support. Nor are they less useful in checking vegetation, and preventing some of the more prolific vegetables from overrunning the whole surface of the earth. It must be admitted, however, that their ravages are often destructive as well as beneficial; and, in order that they may not entirely strip the earth of vegetation, it is necessary that they also should be kept in check. To effect this, one species is made dependent for sustenance upon another. Thus the ichneumon flies are the general enemies of the insect race. They introduce their eggs into the bodies of their victims, which thus, in due time, become a prey to the young ichneumons. Immense numbers of insects are also killed by frost, or picked up by birds; so that, by a system of mutual checks, a constant equilibrium is maintained throughout the realms of nature.

Insects are propagated by means of eggs. Before arriving at maturity, many of these creatures pass through a series of changes of a very remarkable character. This *metamorphosis*, as it is usually called, is exemplified, in its complete form, in the case of beetles, moths, and butterflies,

all of which appear successively in three very distinct stages of development. In the first, which is called the *larva* state, the insect has the form of a grub, maggot, or caterpillar. During this part of its existence, it eats voraciously, changing its skin repeatedly to make room for the rapid increase in its bulk. After a certain time, which varies greatly in different species, it begins to prepare for a period of quiescence. Having chosen a suitable resting-place, and perhaps wrapped itself in leaves, or in a cocoon spun from its own body, it again throws off its caterpillar skin, and there now remains only a small oviform mass, without mouth, eyes, or limbs, and exhibiting scarcely any sign of life. This is called a *pupa* or *chrysalis*.* In this state of torpor it exists for a longer or shorter period, after which,

FIG. 14.

Larva.

FIG. 15.

Pupa.

FIG. 16.

Imago.

having arrived at maturity, it bursts from its prison in the full enjoyment of all its faculties. It is then said to be in the *imago* or perfect state.

This metamorphosis is one of the most striking phenomena in the history of insects, if it be not, indeed, the most marvellous thing in nature. To see the same animal appearing first as a soft worm-like creature, crawling slowly along, and devouring everything that comes in its way, and

* The figures here given represent, in its three different stages of development, one of the most useful insects—the silkworm. The leaf on which the larva is shown is that of the mulberry tree, its favourite food. It is from the cocoon or the chrysalis form that silk is obtained.

then, after an intermediate period of death-like repose, emerging from its torpid state, furnished with wings, adorned with brilliant colours, and confined in its choice of food to the most delicate fluids of the vegetable kingdom, is a spectacle that must always be regarded with the highest interest. Nor can we fail to be struck by the parallel which some entomologists have drawn between these changes and the progress of our own being towards perfection. Here we are but as the *larvæ* of our future selves; our sphere of action is limited, and our nature grovelling. Death brings a period of repose, which may be regarded as our *chrysalis* state. And, if our time here be not misspent, we are encouraged to hope, that, like the insect, we shall again rise from the tomb, endowed with new faculties, to the enjoyment of a nobler and more glorious life.

QUESTIONS FOR EXAMINATION.

Show that the animal kingdom presents a wide field of inquiry. How is the extent of that field affected by diversity of climate? How by the microscope? How by geological discovery? What is meant by vertebrata? Name the classes of the vertebrata. Which is the highest? Name the great divisions of the invertebrata. What is the use of classification in natural history? Why are certain animals called zoophytes? What is the simplest form of animal organism? Name an example of it. How does the amœba move? How does it eat? What are polypes? Name a fresh-water species—a salt-water one. Describe the hydra. In what remarkable way does the hydra species multiply naturally? How may it be multiplied artificially? Give an instance of the hydra's tenacity of life. Describe the sea-anemone. Why so called? Where found? Give an instance of its tenacity of life. How may it be killed? What science treats specially of insects? Of how many segments are insects composed? What is remarkable about their eyes? How many legs have they? How many wings? Name some of the uses of insects. How are their ravages kept in check? In what form does a butterfly issue from the egg? What is its second state? How does it differ from the first? What is its third state? How does it differ from the first? and from the second? Compare this process of development with the progress of a human being towards perfection.

JERUSALEM AT THE SIEGE.

[SIR EDWARD BULWER LYTTON, one of the most elegant novelists of the time, is also a dramatic poet and a powerful satirist, and has lately secured his title to immortality in his noble romance-epic "King Arthur." His plays are the "Lady of Lyons," the "Duchess de la Valliere," and "Richelieu." The lyrical pieces scattered over his novels are remarkable for their pure and classic gracefulness.]

No tragedy on the stàge| has the same scenes of appalling térror| as are to be foúnd in the history of this siège. The city itsélf| was rent by factions at the deadliest wàr with each other—all the elements of civil hátred| had broken lòose—the streets were slíppery with the blood of cìtizens—bróther slew bròther—the granaries were set on fíre—fàminè wasted thóse| whom the swòrd did not slay. In the midst of these civil mássacres, the Roman ármies| appeared before the walls of Jerùsalem. Thèn for a shórt time| the civil factions únited against the common fòe; they were agaìn the gallant coúntrymen of Dávid and Jòshua—they sallied fórth| and scattered the eagles of Ròme. But this tríumph was brìef; the ferocity of the ill-fated Jéws| soon again wásted itself on each òther. And Titus marched òn—encamped his armies close by the wàlls—and from the heíghts| the Roman general gazed with áwe| on the strength and spléndour of the city of Jehòvah. Let us here pàuse, and take a mournful glance of Jerúsalem as it thèn was. The city was fórtified by a triple wàll, save on óne side| where it was protected by deep and impassable ravìnes. These walls, of the most solid másonry, were guarded by strong tòwers; opposite to the lóftiest of these, Titus had encàmped. From the height of that tówer| the sentinel might have seen, stretched bélow, the whole of that fair territory of Judéa, about to pass from the countrymen of Dàvid. Within these wálls| was the palace of the kìngs—its roofs of cèdar, its floors of the rarest márble, its chámbers| filled with the costliest tápestries, and véssels of gold and sìlver. Groves and gárdens gleaming with foùntains, adorned with statues of brónze, divided the courts of the palace itsèlf. But hígh above àll, upon a precipitous róck, rose the tèmple, fortified and adorned by Sòlomon. This temple was as strong withóut| as a cìtadel—withín| more adorned than a pàlace. On éntering, you beheld porticoes of numberless columns of pòrphyry, márble, and àlabaster; gátes adorned with gold and sìlver, among which was the wonderful gáte called the Beaùtiful. Fùrther on, through a vast árch, was the sacred pórtal| which admitted into the interior of the

temple itsèlf—all sheeted over with gòld, and overhung by a vı́ne-tree of gold, the bránches of which| were as large as a màn. The róof of the temple, even on the oùtside, was set over with golden spìkes, to prevent the birds séttling there, and defiling the holy dòme. At a dı́stance, the whole temple looked like a mount of snów, fretted with golden pìnnacles. But, alás, the vèil of that témple| had been already rent asúnder by an inexplicable crìme, and the Lord of hósts| did not fight with I'srael. But the énemy| is thundering at the wàll. All around the cı́ty| arose immense machìnes, from which Titus poured down mighty fragments of róck| and showers of fìre. The walls gave wày—the city was éntered—the temple itsélf was stòrmed. Fàmine in the meantime had made such hávoc| that the besieged were more like spèctres than living men; they devoured the belts of their swórds and the sandals on their fèet. Even nature itsèlf so perished awáy, that a móther devoured her own ìnfant, fulfilling the awful words of the warlike próphet| who had first led the Jews to the land of pròmise—"The tender and delicate wóman amongst you, who would not advénture to set the sole of her foot upon the gròund for delicateness and téndерness, hèr eye shall be evil toward her yoúng one, and the children which she shall bèar; for she shall éat them| for want of àll things| sècretly in the siege and stráitness| wherewith thine enemies shall distress thee in thy gates."

Stíll, as if the fóe and the fàmine were not scóurge enough, citizens smote and múrdered each other| as they met in the wày—false próphets| ran hówling through the strèets—every image of despáir| completes the ghastly picture of the fall of Jerusalem. And nów| the temple itsélf was set on fire, the Jews rushing through the flámes| to perish amidst its rùins. It was a calm summer nı́ght, the 10th of Aùgust, the whole hill on which stood the témple| was one gigantic blaze of fìre, the roofs of cedar cráshed, the golden pinnacles of the dóme| were like spikes of crimson flàme. Through the lurid átmosphere| all was carnage and slaùghter; the echoes of shrieks and yélls| rang back from the Hill of Zı́on

and the Mount of O'lives. Amongst the smóking rùins and over piles of the déad, Titus planted the standard of Ròme. Thus were fulfílled the last avenging pròphecies—thús perished Jerùsalem. In that dreadful dáy, men were still líving who might have heard the warning voice of Hím whom they crùcified: "Vèrily I sáy unto you, All thése things shall come upon this generàtion. . . . O Jerúsalem, Jerúsalem, thóu that killest the pròphets, and stonest them that are sént unto thee . . . behóld, your house is léft unto you dèsolate!" And thus were the Hebrew péople scattered over the face of the eàrth, still retaining to this hóur their mysterious idèntity—stìll a living proof of the truth of those prophets they had scorned or sláin—stíll vàinly awaiting that Messíah whose divine mission was fulfilled eighteen cénturies ago upon the Mount of Càlvary.

BULWER LYTTON.

JERUSALEM.

Fàllen is thy thróne, O Isràel!
  Sílence is o'er thy plàins!
Thy dwèllings all lie désolate,
  Thy chíldren weep in chàins.
Whère are the dews that féd thee
  On E'tham's barren shòre!
The fire from heaven that léd thee
  Now lights thy páth no mòre!

Lórd, thou did'st love Jerùsalem;
  O'nce she was all thine ówn:
Her lòve thy fairest héritage,
  Her pówer thy glory's thròne,
Till èvil came and blíghted
  Thy long-loved òlive-tree,
And Salem's shrines were líghted
  For óther gods than Thee.

Thèn' sank the star of Sólyma,
  Thén' passed her glory's dày,
Like heath that in the wílderness
  The light wínd whirls awày.
Sílent and wàste' her bówers,
  Where ónce the mighty tròd;
And sùnk those guilty tówers,
  Where Báal reigned as Gòd

"Gò," said the Lord, "ye cónquerors,
  Steep in her blóod' your swòrds,
And raze to earth her báttlements,
  For théy are not the Lòrd's.
Tell Zion's mournful dáughter
  O'er kindred bones she'll trèad,
And Hinnom's vale of sláughter'
  Shall híde but hàlf her dead."

But soon' shall òther pictured scenes
  In brighter vision ríse,
When Zion's sun shall sevenfold shíne
  On all her mourners' eỳes;
And on her moùntains' beauteous stánd
  The méssengers of pèace;—
"Salvàtion by the Lord's right hánd!"
  They shóut' and never cèase.

MOORE.

OF VALUE.

THAT quality in any object which renders it capable of gratifying our desires, is called its *value*. It is not always the most useful things that are of the most value. Nothing is more useful than air and water, without which we could not live; yet these are, in most places, of no value in the proper sense of that word: that is, no one will give anything in exchange for them, because he can have them

without. In some places, indeed, water is scarce, and then people are glad to buy it. But water is not more *useful* in those places where people are glad to buy it, than it is here, where, by the bounty of Providence, it is plentiful. It is the *scarcity* that gives it value; and where iron is scarce, there it is of great value.

Scarcity alone, however, would not make a thing valuable, if there were no reason why any one should *desire* to possess it. There are some kinds of stones which are scarce, but of no value, because they have neither use nor beauty. You would not give anything in exchange for such a stone; not because you can easily get it, but because you have no *wish* for it. But a stone which is scarce and very *beautiful* may be of great value, though it is of no *use* but to make an ornament for the person. Such are diamonds and rubies, and many others. Many people will work hard to earn money enough to buy, not only food and necessary clothing, but also lace and jewels, and other articles of finery. And they desire these things the more, because, besides being beautiful to the eye, they are reckoned a *sign of wealth* in the person who wears them. A bunch of wild flowers will often be a prettier ornament than a fine riband or a jewel: but a woman likes better to wear these last, to show that she can afford the cost of them, whereas the wild flowers may be had for picking.

You understand now, I hope, that whatever is of value must not only be *desirable,* for its use or beauty, or some pleasure it affords, but also *scarce;* that is, so *limited* in supply that it is not to be had for nothing. And of things which are desirable, those are the *most* valuable which are the most limited in supply; that is, the hardest to be got. This is the reason why silver and gold are of more value than iron. If they had been of no use or beauty at all, no one would have ever *desired* them; but being desirable, they are of greater value than iron, because they are so much scarcer and harder to be got. They are found in but few places, and in small quantities. Gold, in particular, is obtained chiefly in the form of dust, by laborious washing

of the sand of certain streams. It costs only as much, in labour and other expenses, to obtain about fifteen pounds of silver, as to obtain one pound of gold; and this is the cause that one pound of gold will exchange for about fifteen pounds of silver.

But besides being desirable and being scarce, there is one point more required for a thing to have value. It must be something that you can *part with* to another person. For instance, *health* is very desirable, and is what every one cannot obtain; and hence, we sometimes do speak of health as being of value, but this is not the strict use of the word value; for no one can give his health to another in exchange for something else. Many a rich man would be glad to give a thousand pounds, or perhaps ten thousand pounds, in exchange for the healthy constitution and strong limbs of a poor labourer, and perhaps the labourer would be glad to make such a bargain: but though he might cut off his limbs, he could not make them another man's. He might throw away his health (as many do) by intemperance, but he cannot *transfer* it; that is, part with it to another person.

When anything that is desirable is to be had by labour, and is not to be had *without* labour, of course we find men labouring to obtain it; and things that are of very great value will usually be found to have cost very great labour. This has led some persons to suppose that it is the labour which has been bestowed on anything that *gives* its value. But this is quite a mistake. It is not the labour which anything has cost that *causes* it to sell for a high price; but, on the contrary, it is its selling for a high price that causes men to labour in procuring it. For instance, fishermen go out to sea, and toil hard in the wet and cold to fish, because they can get a good price for them: but if a fisherman should work hard all night, and catch but one small fish, while another had, perhaps, caught a thousand, by falling in with a shoal, the first would not be able to sell his one fish for the same price as the other man's thousand, though it would have cost him the same labour. It has now and then happened that a salmon or a sturgeon has leaped into

a boat by chance; but though this has cost no labour, it is not for that reason the less valuable. And if a man, in eating an oyster, should chance to meet with a fine pearl, it would not sell for less than if he had been diving for it the whole day.

It is not, therefore, labour that makes things valuable, but their being valuable that makes them worth labouring for. And God having judged in his wisdom that it is not good for man to be idle, has so appointed things by his providence, that few of the things that are most desirable can be obtained without labour. It is ordained for man to eat bread in the sweat of his face; and almost all the necessaries, comforts, and luxuries of life, are obtained by labour.

ARCHBISHOP WHATELY.

SOLILOQUY ON SLEEP (HENRY IV.).

How many thòusands of my poorest súbjects!
Are at this hour aslèep ! O gentle sléep,
Náture's soft nùrse, hòw have I fríghted thee,
That thou no more wilt weigh my eyelids dówn,
And steep my sénses! in forgètfulness ?
Whỳ rather, sléep, liest thou in smoky crìbs,
Upon uneasy pàllets stretching thee,
And húshed with buzzing nìght-flies to thy slúmber,
Than in the perfumed chambers of the grèat,
Under the canopies of costly státe,
And lulled with sóunds! of sweetest mèlody?
Wilt thou, upon the hígh and giddy màst,
Séal up the shìp-boy's eyes, and rock his bráins!
In cradle of the rude imperious súrge;
And in the visitátion of the wìnds,
Who take the ruffian billows by the tóp,
Curling their monstrous hèads, and hanging them!
With deafening clamours in the slippery clouds,
That, with the húrly, death itsèlf awákes ?

Càn'st thou, O pàrtial sleep, give thy repóse!
To the wet sèa-boy! in an hour so rúde,
And, in the cálmest and most stillest nìght,
With all appliances and means to bòot,
Deny it to a kíng? Then, happy lów, lie down!
Uneasy lies the héad! that wears a cròwn.

SHAKSPEARE.

CROMWELL.

[THE RIGHT HON. T. B. MACAULAY was born in 1800, and died in 1860. He is distinguished as an historian, an orator, and a poet. For many years he represented the city of Edinburgh in the House of Commons, and held several important offices in the Privy Council. His speeches in Parliament were generally marked with fervid eloquence, and his ballads, the "Lays of Rome," are characterised by fervour and graphic simplicity. His History of England, which has so exalted his reputation, exhibits, in its pictorial passages, all the qualities of epic description.]

CRÓMWELL passed his yoùth! and the prime of his mánhood! in a cìvil situation. He never looked on wár! till he was móre than forty years of àge. He had first to form himsélf, and thén! to form his tròops. Out of raw lèvies! he created an ármy, the brávest and the best dìsciplined, the most orderly in pèace, and the most terrible in wár, that Europe had sèen. He called this bódy! into exìstence. He léd it to cònquest. He never fóught a battle! without gàining it. He never gáined a battle! without anníhilating the force oppòsed to him. Yet his víctories! were not the hìghest glory of his military system. The respéct! which his troops paid to pròperty, their attáchment to the laws and religion of their coùntry, their submission to the civil pòwer, their tèmperance, their intèlligence, their índustry, are without pàrallel. It was after the Restoràtion, that the spirit which their great leader had infúsed into them! was most sìgnally displayed. At the command of the established góvernment—an established government which had no means of enforcing obédience—fifty thousand sòldiers! whose bácks! no enemy had ever sèen, either in domèstic or in continéntal war, laid down their árms, and retired into the mass of

the pèople, thencefórward| to be distinguished only by superior dìligence, sobrìety, and regulárity in the pursuits of péace, from the other members of the commúnity| which they had sàved. Crómwell| was emphátically| a màn. He possèssed, in an eminent degrée, that masculine and full-grown robustness of mìnd, that equally diffused intellectual héalth, which, if our national partiàlity does not misléad us, has pecùliarly chàracterised the great men of E`ngland. Never was àny ruler| so conspícuously bòrn for sovereignty. The cup which has intoxicated almost all óthers| sobered hìm. His spírit, restless from its own bùoyancy in a lówer sphere, reposed in majestic placídity| as soon as it had reached the lével congènial to it. He had nóthing in còmmon with that large class of mén| who distínguish themselves in subòrdinate posts, and whose incapacity becomes óbvious| as soon as the public vóice| summons them to take the lèad. Ràpidly as his fórtunes grew, his mínd| expanded more rapidly stìll. Insignìficant as a private cítizen, he was a gréat gèneral; he was a still greater prìnce. By the conféssion even of his ènemies, he exhibited in his deméanour| the simple and natural nòbleness of a mán| neither ashamed of his órigin, nor vain of his elevàtion, of a mán| who had found his proper place in socíety, and who felt secúre| that he was competent to fìll it. E´asy, even to familiàrity, where his own dígnity was concerned, he was punctílious| only for his coùntry. His ówn character| he left to take care of itsèlf; he léft it| to be defènded by his victories in wár, and his reforms in pèace. But he was a jealous and implacable guárdian| of the public hònour. He suffered a crazy Quàker| to insult him in the gallery of Whítehall, and revènged himself only by líberating him| and giving him a dìnner. But he was prepared to risk the chances of wár| to avenge the blóod of a private E`nglishman.

Nò sovereign ever carried to the thróne| so lárge a portion| of the best qualities of the mìddling orders, so strong a sýmpathy| with the feelings and interests of his pèople. He was sòmetimes driven to árbitrary measures; but he had a hìgh, stóut, hónest, E´nglish heàrt. Hènce it wás|

that he loved to surround his thróne| with such mén as Hále and Blàke. Hènce it wás| that he allowed so làrge a share of political liberty to his sùbjects, and that, even when an opposítion| dangerous to his pówer and to his pèrson| almost compèlled him to govern by the swórd, he was stìll anxious to leave a gérm| from which, at a more fávourable season, free institutions might sprìng. We firmly beliève, that, if his first Pàrliament| had not commenced its debates by disputing his títle, his gòvernment would have been as mild at hóme| as it was energetic and áble abròad. He was a sòldier, he had rìsen by war. Had his ambition been of an impure or sélfish kind, it would have been èasy for him| to plunge his country into continental hostilities on a large scále, and to dàzzle the restless factions which he rúled, by the splendour of his vìctories. Sòme of his enemies have sneeringly remárked, that in the succèsses obtained under his administrátion| he had no pèrsonal share; as if a man who had raised himself from obscurity to émpire| sòlely by his military tálents| could have any unworthy réason| for shrinking from military ènterprise. This reprŏach| is his highest glòry. In the success of the English návy| he could have no sèlfish interest. Its tríumphs| added nothing to his fàme; ìts incréase| added nothing to his means of overawing his énemies; its great léader| was not his friènd. Yet he took a peculiar pleàsure in encouraging that noble sérvice, which, of àll the instruments employed by an English góvernment, is the most important for míschief, and the most powerful for gòod. His administration was glórious, but with no vùlgar glory. It was not òne of those periods of overstrained and convulsive exértion| which nècessarily produce debility and lángour. Its énergy| was nàtural, héalthful, tèmperate. He placed E'ngland| at the head of the Protestant ínterest, and in the first ránk of Christian pòwers. He taught èvery nation| to value her friéndship| and to dread her ènmity. But he did not squander her resòurces| in a vain attémpt| to invest her with that suprémacy, which nò power, in the módern system of Europe, can safely affést, or can long retàin.

This noble and sober wísdom| had its rewàrd. If he did not carry the banners of the Còmmonwealth| in triumph to distant cápitals, if he did not adorn Whìtehall| with the spoils of the Stadthouse and the Loúvre, if he did not portion out Flanders and Gèrmany| into principalities for his kinsmen and his génerals, he díd not, on the òther hand, see his country overrun by the armies of nátions| which his ambition had provòked. He went down to his gráve| in the fulness of power and fàme; and he left to his sòn an authórity| which àny man of ordinary firmness and prúdence| would have retàined.

The most blàmable act of his lífe| was the execution of Chàrles. While strongly condèmning that proceeding, we by nò means consider it as óne| which attaches any pecùliar stigma of infamy to the names of thóse| who particìpated in it. It was an unjúst and injudìcious display of violent party spírit; but it was not a crúel or perfìdious measure. It had àll those features| which distinguish the errors of magnanimous and intrepid spírits| from base and malignant crìmes.

MACAULAY.

THE HEALING OF THE DAUGHTER OF JAIRUS.

[NATHANIEL PARKER WILLIS, one of America's best poets, is the author of a volume of poems, sacred and miscellaneous. His largest poem is "The Lady Jane," and the best effusions of his muse are "Jephthah's Daughter," and the "Healing of Jairus' Daughter."]

FRESHLY the cool breath of the coming éve|
Stole through the làttice, and the dying gírl|
Félt it| upon her fòrehead. She had lain
Since the hot nóontide| in a breathless trànce,
Her thin pale fíngers| clasped within the hánd
Of the heart-broken Rùler; and her brèast,
Like the dead márble, whíte and mòtionless.
The shadow of a léaf| lay on her lips,
And as it stirred with the awakening wínd,
The dark líds| lifted from the languid eỳes,

And her slight fíngers mòved, and héavily
She turned upon her pillow. Hè was there,
The same lóved, tìreless watcher, and she looked
Into his fáce until her sight grew dím
With the fast falling tèars, and with a sigh
Of tremulous wéakness, murmuring his náme,
She gently drew his hand upon her líps,
And kíssed it as she wèpt. The old mán sunk
Upon his knèes, and in the drapery
Of the rich cúrtains buried up his fàce—
And when the twilight féll, the silken fólds
Stírred with his pràyer, but the slight hánd he held
Had ceased its prèssure, and he could not hear
In the dead, utter sílence, that a bréath
Came through her nòstrils, and her témples gave
To his nice toúch no pùlse; and at her móuth
He held the slightest cùrl that on her neck
Lay with a mocking beaúty, and his gáze
Ached with its deathly stìllness.

Like a form
Of matchless scúlpture in her sleep she lày—
The linen vésture folded on her brèast,
And óver it her whíte transparent hànds,
The blood still rósy in her tapering nàils;
A line of péarl ran through her parted lìps,
And in her nóstrils, spìritually thín,
The breathing cúrve was móckingly like lìfe;
And roùnd beneath the faintly tinted skín
Ran the light bránches of the azure vèins—
And on her chèek the jet lash overláy,
Matching the árches pencilled on her bròw.
Her háir had been unboùnd, and falling loose
Upon her píllow, hid her small round éars
In curls of glossy blàckness, and about
Her polished néck, scarce toùching it, they hung
Like airy shádows, flóating as they slèpt.
'Twas hèavenly beautiful. The Sáviour raised

Her hand from off her bòsom, and spreád out
The snowy fíngers in his pàlm, and sáid—
"Māiden! Arìse!"—And súddenly! a flúsh
Shòt o'er her fórehead! and along her lìps,
And through her chéek! the rallied colour ràn,
And the still outline of her graceful fórm!
Stirred in the linen vèsture; and she clásped
The Saviour's hànd, and, fixing her dark éyes!
Fùll on his beaming coúntenance—aròse!

WILLIS.

THE ANIMAL KINGDOM.—VERTEBRATA.

Cartilage, (*cartilage*, L.) gristle. Hence *cartilaginous*, made of gristle.
Cord or *chord*, (*chorda*, L.; *chordé*, G.) a string or small rope. The nervous matter contained in the spine is called the *spinal cord* or *spinal marrow*.
Gland, (*glans*, L.) an organ for secreting or separating some particular material from the blood.
Nerve, (*nervus*, L.; *neuron*, G.) The nerves are white thread-like organs proceeding from the brain and spinal cord to all parts of the body. They are the organs of sensation, and direct the organs of motion. Hence *nervous*. The *nervous system* includes the brain, spinal cord, and nerves.
Spine, (*spina*, L.) the backbone, so called from the thorn-like processes of the vertebræ. Hence *spinal*.

STRUCTURE OF VERTEBRATE ANIMALS.

VERTEBRATE animals are distinguished from all others by the possession of an internal skeleton, which is usually bony, but in a few species cartilaginous. This skeleton consists essentially of a *skull* and *vertebral column*, to which ribs, limbs, &c., are in most cases attached. The skull serves as a case or receptacle for the *brain*. The vertebral column, spine, or backbone, is formed of a number of distinct pieces, called *vertebræ*, more or less firmly jointed together. It is pierced lengthwise by a canal running through each vertebra, and containing the *spinal cord* or *marrow*, which may be regarded as a continuation of the *brain*. The two together form the centre of the *nervous system*, that singular mechanism, if we may so call it, by means of which the animal is enabled to feel, to direct its own motions, and to ascertain what is going on around it.

The *limbs* are the organs of locomotion. None of the vertebrates have more than four, some only two; and, in the case of serpents, they entirely disappear. Intended by nature for different purposes, and suited to different modes of life, these organs assume an immense variety of forms. But however great may be the modifications which they present, the general plan on which they are constructed is never wholly departed from. At first sight, indeed, the wing of a bird seems very unlike the arm of a man, or the foreleg of a horse, but, when the skeleton only is considered, they are found to resemble one another closely, both in the form, number, and arrangement of the bones. Nor are even the fins of fishes so entirely dissimilar as to defy comparison.

The different *classes* of the vertebrates—*mammals*, *birds*, *fishes*, and *reptiles*—are, in general, easily distinguished. There are, however, a few mistakes which it is well to guard against. The whale, for example, is usually spoken of as a fish, and the bat is sometimes supposed to be a bird, though the proper place of both is among the mammals. So also among the reptiles we should reckon not only serpents, to which alone the name is strictly applicable, but also frogs, tortoises, lizards, crocodiles, and other creatures of a like description. A few distinctive characteristics of each class may be mentioned.—The mammals include all those animals, and those only, which produce their young alive, and suckle them. They are accordingly provided with teats or paps (*mammæ*), from which they derive their name. The young of all other vertebrate animals are produced from eggs. Birds are a well-defined class, and may be at once recognised by their covering of feathers, and by the structure of their wings, which are also clothed with strong feathers or quills. Their blood, as well as that of the mammals, is warm; whereas, in reptiles and fishes, the blood is cold. Finally, the last two classes may be distinguished by their organs of respiration. Fishes alone of all animals breathe by means of gills; the other classes are furnished with lungs.

The *mammals*, by their superiority in organization and

intelligence, are naturally placed at the head of the animal creation. No other class possesses the same interest for man, for it is the class of which he is himself a member. It is the class which contains his favourite domesticated animals, such as the dog, the horse, the ox, and the sheep. It is the class on which he is chiefly dependent for the conveniences and even the necessaries of life. And, to omit other particulars, it is the class in whose structure he finds the most striking exhibitions of creative wisdom. The nervous system, especially, attains in most of the mammals a perfection elsewhere unknown. As we ascend from the lower to the higher orders, the brain becomes more and more fully developed, till, in the case of man, it forms the connecting link between the material and the spiritual, between the mortal and the immortal.

The human body is, indeed, the noblest type of vertebrate structure. For this reason, and also on account of the intrinsic interest and importance of the subject, a description of some of its parts and functions will occupy several subsequent lessons.

THE COVERING OF ANIMALS.

It has been stated that the blood of mammals and birds is warm; of reptiles and fishes, cold. Now, it is worthy of notice that warm-blooded animals are provided by nature with some kind of covering, to prevent the heat of their bodies from escaping too rapidly, so as to reduce them to a temperature inconsistent with the healthy exercise of their functions.

It has to be remarked, however, that such coverings are in many cases armour as well as clothing, intended for protection as well as warmth. Nor is this protection bestowed upon warm-blooded animals only; on the contrary, fishes and reptiles are nearly all armed with scales, which, while they protect, do not encumber or overburden them. There is, indeed, scarcely any part of the structure of animals

more worthy of admiration than their covering, whether we look to its variety, or its suitableness to their several natures. We have bristles, hair, wool, fur, feathers, quills, prickles, scales; yet, in this diversity both of material and form, we cannot change one animal's coat for another, without evidently changing it for the worse.

Of the higher animals, man is the only one that is naked, and the only one that can clothe himself. This is one of the properties which render him an animal of all climates, and of all seasons. He can adapt the warmth or lightness of his covering to the temperature of his habitation. Had he been born with a fleece on his back, although he might have been comforted by its warmth in high latitudes, it would have oppressed him by its weight and heat, as the species spread towards the equator.

What art, however, does for man, nature has in many instances done for those animals which are incapable of employing art. Their clothing, of its own accord, changes with their necessities. This is particularly the case with that large tribe of quadrupeds which are covered with fur. Every dealer in hare-skins and rabbit-skins knows how much the fur is thickened by the approach of winter. It seems to be a part of the same constitution and the same design, that wool in hot countries *degenerates*, as it is called, but in truth (most happily for the animal's ease) passes into hair; whilst, on the contrary, hair on the dogs of the polar regions is turned into wool, or something very like it.

The covering of birds, and its adaptation to their necessities, can scarcely escape the notice of the most superficial observer. Its lightness, its smoothness, its warmth, the disposition of the feathers all inclined backwards, the down about their stems, the overlapping of their edges, their different configuration in different parts of the body, not to mention the variety of their colours, constitute a vestment so beautiful, and so appropriate to the life which the animal is to lead, that, if we had never seen it, we should have had no conception of anything so perfect. Nor can we even now imagine anything more so.

Scarcely less remarkable is the apparatus provided for keeping this beautiful garment in good order. From a gland, or bag, situated near the tail, the bird extracts, by the pressure of its bill, an oily fluid with which to dress itself. You may often see it engaged in this process, working with its bill among its feathers. The feathers, smeared with oil, throw off the rain which falls upon them, without being wet or injured by it. It is a curious circumstance, that swimming birds, such as ducks, geese, and swans, not only have a thicker and warmer covering on those parts of the body that are exposed to the water, but are also abundantly supplied with this dressing oil; whereas little or none of it is found in hens and other domestic fowl, which usually have the means of artificial shelter.

Such are some of the minute, yet beautiful adaptations, which are everywhere met with through the works of nature. While we think with admiring gratitude of the benevolence of Him who doeth all this, is it not comforting to reflect that we, too, are under the protection of the same gracious hand?

QUESTIONS FOR EXAMINATION.

Of what substance is the skeleton of vertebrate animals composed? What are its essential parts? What are the two central portions of the nervous system? How are they protected? What is the use of the nervous system? of the limbs? Which vertebrates have no limbs? How are mammals distinguished? How birds? How reptiles? How fishes? Which classes are warm-blooded? which cold? which breathe by gills? Why are mammals the most interesting to us? Why have animals coverings? Which of the higher animals has no natural covering? Is the want of it a gain or a loss? Show how. What is the usual covering of cold-blooded animals? Why is it suitable for them? Describe the effect of climate on the covering of animals. What constitutes the excellence of a bird's covering? How do birds keep their feathers in order?

TIDES.

Tides, or the alternate flowing and ebbing of the sea, are produced by the attraction of the moon and sun, but principally by the attraction of the moon. For the moon being so much nearer to the earth than the sun, has a much greater attractive influence on its waters than the sun.

The ancients looked upon the flowing and ebbing of the tides as one of the greatest mysteries in nature; and but for the more than human intellect of Newton, it is probable that it would have remained a mystery to this day.

The phenomenon of the tides has been observed in every part of the earth which has been washed by the sea. For about six hours the sea gradually swells, so that it enters the mouths of harbours and rivers, and comes nearer to the coasts. This is called *Flood Tide*. For about twelve minutes it rests or remains in *equilibrio;* during which it is said to be *high water*. It then begins to ebb, and continues to do so for about six hours, when it pauses again for about twelve minutes; during which it is said to be *low water*. It then begins to flow again for six hours; and so on alternately. Hence, in every twenty-four hours and fifty minutes there are two tides. If the moon were stationary, the same part of our globe would return under or opposite to it every twenty-four hours, and there would, in consequence, be two tides every twenty-four hours; but while the earth is turning once upon its axis, the moon moves forward in her orbit 13°, and hence it takes the earth about fifty minutes more to bring the same meridian under or opposite to the moon.

As the earth turns round on its axes, it presents every part of its surface, in succession, to the moon, which, in accordance with the law of gravity, exerts a greater attractive influence upon those parts of the earth's surface that are turned towards her, or nearest, than upon those that are turned from her, or most remote. Hence, as seas pass under the moon—or, as is commonly said, when the moon comes to the meridian of the place—the fluid particles of which they are composed, being more easily separated and attracted than particles of earth, are drawn more strongly towards her, which causes them to swell and bulge out, till the impulse is overcome by the attraction of the other watery particles, as they are brought by the rotation of the earth, under the more direct influence of the moon.

While the water is thus attracted and heaped up on the side of the earth which is nearest to the moon, it is at the

same time equally elevated on the other side of the earth, or the side which is farthest from the moon; and hence there are always two tides at the same time, one on the side of the earth next to the moon, and the other on the opposite side.

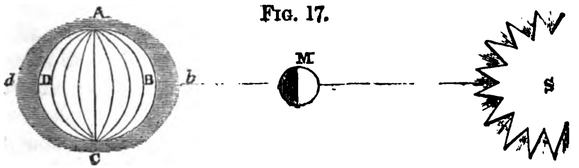
It is evident that the tides will be greatest at that point of the earth's surface which is nearest to the moon, or where the latter is vertical. She is so between the tropics; and accordingly the tides are there greatest, and they diminish as we approach either pole. It is further to be remarked, that the tide is not highest when the moon is on the meridian of the place. From two to three hours elapse before the waters are raised, in consequence of the law of inertia, or a disposition which every body has to continue in the condition of motion or rest in which it happens to be placed.

That the moon should attract and raise up the waters of the earth that are under her, is easy to conceive; but that the same cause should, at the same time, raise them up on the opposite side of the globe, seems strange and incredible. The general principle is, that as those parts of the earth which are nearest to the moon are more strongly attracted towards her than the parts which are more remote, the *sea* which covers the surface of the earth on the side farthest from the moon is less strongly attracted than the land which is under it, and which is consequently nearer to the moon. Hence the body of the earth being more strongly attracted than the waters which cover its side farthest from the moon, is drawn away from these waters, and the same result is produced as if they had risen in tides.

The following diagrams will illustrate more clearly the action of the sun and moon upon the waters. Suppose that the earth were a regular and uniform sphere covered with water. If no external body or influence operated on this system, it is clear that the waters would, in obedience to the law of gravitation, arrange themselves regularly and uniformly around the earth, forming a coating or bed everywhere of the same depth. Let an external body, M, the

moon, be called into being, and the effects which have already been described will be produced.

FIG. 17.



Let A B C D represent the earth, M the moon, and S the sun. There will be high water at B and D; and low water at A and C.

The moon's attractive force at B evidently tends to raise the waters towards *b*, and to draw them from A and C towards *b*. Also, as the land at D is more attracted by M than the waters which lie above it, the land must recede to a certain extent from these loose waters and cause them to be proportionally elevated. Hence there is high water at B, where the moon is on the meridian, and also at the opposite meridian D.

At new and full moon the attraction of the sun is added to that of the moon, and the tides are in consequence raised higher; but when the moon is in her quarters the attraction of the sun and moon act in different directions, the attraction of the one raising the waters, while that of the other has the effect of depressing them, and lower tides than usual are produced. The former are called *Spring*, and the latter *Neap* tides.

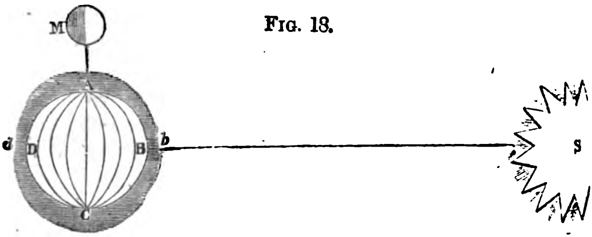
In the preceding figure, spring tides are represented at *b* and *d*, because there the moon (M) and the sun (S) combine their attractive influence to raise the waters.

In the following diagram, neap tides are represented.

M is the moon in one of her quarters. It is evident that her power to raise the waters at A is counteracted and lessened by the attraction of the sun at B, which prevents

the waters from falling so low there, and consequently from rising so high at A.

FIG. 18.



In inland seas and lakes, as in the Baltic and Mediterranean, the surface is so small, comparatively speaking, that it is all equally attracted at the same time, and there is scarcely any tide perceptible. But in bays, harbours, and seas open in the direction of the great tidal wave from oceans, as in Baffin's and Hudson's bays and the Red Sea, there are regular and often very high tides. In the British Channel the tide sometimes rises forty or fifty feet; and in the Bay of Fundy it rises sixty, and often so rapidly that cattle feeding on the shore have been drowned before they could escape. At the mouths of large rivers opening in the direction of the tidal wave, as the Indus and the Ganges, tides often rise to the height of thirty, and even forty feet, and sometimes with destructive rapidity.

Among the natural phenomena of the South Sea Islands, the tide is one of the most singular, and presents as great an exception to the ordinary theory as is to be met with in any part of the world. The rising and falling of the waters of the ocean appear, if influenced at all, to be so in a very small degree only, by the moon. The height to which the water rises varies but a few inches during the whole year, and at no time is it elevated more than a foot, or a foot and a half. The sea, however, often rises to an unusual height; but this appears to be the effect of a strong wind blowing for some time from one quarter, or the heavy swells of the

sea, which flow from different directions, and prevail equally during the time of high and low water. But the most remarkable circumstance is, the uniformity of the time of high and low water. During the year, whatever be the age or situation of the moon, the water is lowest at six in the morning, and the same hour in the evening, and highest at noon and midnight. This is so well established, that the time of night is marked by the ebbing and flowing of the tide; and in all the islands, the term for high water and midnight is the same.—*Compiled.*

THE DELUGE.

The judgment was at hand. Before the sun
Gathered tempestuous clouds, which, blackening, spread
Until their blended masses overwhelmed
The hemisphere of day: and, adding gloom
To night's dark empire, swift from zone to zone
Swept the vast shadow, swallowing up all light
And covering the encircling firmament
As with a mighty pall! Low in the dust
Bowed the affrighted nations, worshipping.
Anon the o'ercharged garners of the storm
Burst with their growing burden; fierce and fast
Shot down the ponderous rain, a sheeted flood
That slanted not before the baffled winds,
But, with an arrowy and unwavering rush,
Dashed hissing earthward. Soon the rivers rose,
And roaring fled their channels; and calm lakes
Awoke exulting from their lethargy,
And poured destruction on their peaceful shores.

The lightning flickered in the deluged air,
And feebly through the shout of gathering waves
Muttered the stifled thunder. Day nor night
Ceased the descending streams; and if the gloom
A little brightened, when the lurid morn

Rose on the starless midnight, 'twas to show
The lifting up of waters. Bird and beast
Forsook the flooded plains, and wearily
The shivering multitudes of human doomed
Toiled up before the insatiate element.

Oceans were blent, and the leviathan
Was borne aloft on the ascending seas
To where the eagle nestled. Mountains now
Were the sole land-marks, and their sides were clothed
With clustering myriads, from the weltering waste
Whose surges clasped them, to their topmost peaks,
Swathed in the stooping cloud. The hand of death
Smote millions as they climbed; yet denser grew
The crowded nations, as the encroaching waves
Narrowed their little world.

And in that hour,
Did no man aid his fellow. Love of life
Was the sole instinct; and the strong-limbed son,
With imprecations, smote the palsied sire
That clung to him for succour. Woman trod
With wavering steps the precipice's brow,
And found no arm to grasp on the dread verge
O'er which she leaned and trembled. Selfishness
Sat like an incubus on every heart,
Smothering the voice of love. The giant's foot
Was on the stripling's neck; and oft despair
Grappled the ready steel, and kindred blood
Polluted the last remnant of that earth
Which God was deluging to purify.
Huge monsters from the plains, whose skeletons
The mildew of succeeding centuries
Has failed to crumble, with unwieldy strength
Crushed through the solid crowds; and fiercest birds,
Beat downward by the ever rushing rain,
With blinded eyes, drenched plumes, and trailing wings,
Staggered unconscious o'er the trampled prey.

The mountains were submerged; the barrier chains
That mapped out nations sank; until at length
One Titan peak alone o'ertopped the waves,
Beaconing a sunken world. And of the tribes
That blackened every alp, one man survived:
And he stood shuddering, hopeless, shelterless,
Upon that fragment of the universe.
The surges of the universal sea
Broke on his naked feet. On his grey head,
Which fear, not time, had silvered, the black cloud
Poured its unpitying torrents; while around,
In the green twilight dimly visible,
Rolled the grim legions of the ghastly drowned,
And seemed to beckon with their tossing arms
Their brother to his doom.

He smote his brow,
And, maddened, would have leapt to their embrace,
When, lo! before him, riding on the deep,
Loomed a vast fabric, and familiar sounds
Proclaimed that it was peopled. Hope once more
Cheered the wan outcast, and imploringly
He stretched his arms forth toward the floating walls,
And cried aloud for mercy. But *his* prayer
Man might not answer, whom his *God* condemned.
The ark swept onward, and the billows rose
And buried their last victim!

Then the gloom
Broke from the face of heaven, and sunlight streamed
Upon the shoreless sea, and on the roof
That rose for shelter o'er the living germ
Whose increase should repopulate a world.

Anon.

NEGRO SLAVERY.

I TRUST[1] that at lèngth the time is cóme[1] when Párliament[1] will no lònger bear to be tóld, that sláve-owners[1] are the

best làw-givers on slavery—nò longer suffer our voice' to roll across the Atlántic' in empty wárnings and fruitless òrders. Téll me not of rìghts—tálk not of the pròperty of the planter in his slaves. I denŷ his right, I acknòwledge not the property. The prínciples, the féelings, of our common nàture, ríse in rebèllion against it. Be the appeal made to the understánding' or to the heàrt, the sentence is the sáme' that rejècts it. In váin you tell me of làws' that sanction such a claim! There is a láw' above all the enactments of hûman codes—the sáme' throughout the wòrld—the sáme in àll times—such as it wás' before the daring genius of Colúmbus' pierced the night of àges, and ópened' to òne world' the sources of pòwer, wèalth, and knówledge; to anóther' all unutterable wòes—súch is it' at this dày—it is the làw' written by the finger of Gód' on the heart of màn; and by thát law, unchángeable and etèrnal, while men despise fràud, and loathe rapìne, and hate blóod, they shall rejéct' with indignàtion' the wild and guilty phántasy, that mán' can hold pròperty in man! In váin you appeal to trèaties, to covenants between nàtions. The covenants of the Almìghty, whether the òld covenant' or the néw, denòunce such unholy pretensions. To thèse laws did thèy of óld refer' who máintained the African tràde. Such treaties did they cíte, and not untrùly; for, by one shameful cómpact, you bartered the glories of Blénheim' for the traffic in blòod. Yét, in despìte of law and of tréaty, that infernal tráffic' is now destròyed' and its vòtaries put to déath' like other pìrates. Hòw came this change to pass? Nòt, assuredly, by Párliament leading the way; but the coùntry at length awoke; the indignation of the pèople' was kindled; it descended in thúnder, and smòte the traffic, and scattered its guilty profits to the wìnds. Nòw, then, let the plánters' bewàre—let their assèmblies beware—let the government at hòme beware—let the Pàrliament beware! The sáme country' is once mòre awake to the condition of Negro slavery; the sáme indignation' kindles in the bosom of the pèople; the same cloud is gáthering' that annìhilated the slave-trade; and if it shall descend agáin, they' on

whom its crash may fáll! will not be destróyed! before I have wàrned them; but I pràỳ! that théir destruction! may turn awáy from us! the more tèrrible judgments of God.

LORD BROUGHAM.

LUCY.

[WILLIAM WORDSWORTH, one of the greatest poets of our age and country, was born at Cockermouth in Cumberland, in 1770, and died in 1850. After the completion of his studies at Cambridge and a short tour on the Continent, he retired to "Rydal Mount," where a great portion of his life was passed amidst the mountain seclusion of the Lakes in Westmoreland. His writings are characterised by a high tone of moral purity and religious fervour, and are frequently robed in imagery of glowing eloquence. Wordsworth has exercised no small influence in moulding the poetic taste of the present age. The whole of the poetry that has issued from the English press for years, has been tinctured and coloured with the regenerative power of his genius. His greatest work is "The Excursion."]

Three years she grew in sun and shower,
Then Nature said, "A lovelier flower
  On earth was never sown;
This child I to myself will take;
She shall be mine, and I will make
  A Lady of my own.

"Myself will, to my darling, be
Both law and impulse: and with me
  The girl, on rock and plain,
In earth and heaven, in glade and bower,
Shall feel an overseeing power,
  To kindle or restrain.

"She shall be sportive as the fawn,
That, wild with glee, across the lawn,
  Or up the mountain springs;
And her's shall be the breathing balm,
And her's the silence, and the calm
  Of mute insensate things.

"The floating clouds their state shall lend
To her; for her the willow bend;
  Nor shall she fail to see,

Even in the motions of the storm,
Grace that shall mould the maiden's form
By silent sympathy.

"The stars of midnight shall be dear
To her; and she shall lean her ear,
In many a secret place,
Where rivulets dance their wayward round;
And beauty, born of murmuring sound,
Shall pass into her face.

"And vital feelings of delight
Shall rear her form to stately height,
Her virgin bosom swell;
Such thoughts to Lucy I will give,
While she and I together live,
Here in this happy dell."

Thus Nature spake—The work was done.
How soon my Lucy's race was run!
She died, and left to me
This heath, this calm, and quiet scene;
The memory of what has been,
And never more will be.

WORDSWORTH.

THE INQUIRY.

Tell me, ye winged winds,
That round my pathway roar,
Do ye not know some spot
Where mortals weep no more?
Some lone and pleasant dell,
Some valley in the west,
Where, free from toil and pain,
The weary soul may rest?
The loud wind dwindled to a whisper low,
And sighed for pity as it answered,—"No."

Tell me, thou mighty deep,
Whose billows round me play,
Knowest thou some favoured spot,
Some island far away,

Where weary man may find
The bliss for which he sighs,—
Where sorrow never lives,
And friendship never dies?
The loud waves, rolling in perpetual flow,
Stopped for a while, and sighed to answer,—"No."
And thou serenest moon,
That, with such lovely face,
Dost look upon the earth
Asleep in night's embrace;
Tell me in all thy round,
Hast thou not seen some spot,
Where miserable man
May find a happier lot?
Behind a cloud the moon withdrew in woe,
And a voice sweet, but sad, responded,—"No."
Tell me, my secret soul,
Oh! tell me, Hope and Faith,
Is there no resting-place
From sorrow, sin, and death?
Is there no happy spot,
Where mortals may be blessed,
Where grief may find a balm,
And weariness a rest?
Faith, Hope, and Love, best boons to mortals given,
Waved their bright wings, and whispered,—"Yes,
IN HEAVEN!" MACKAY.

STRUCTURE OF THE HUMAN BODY.

Compages, (L.) a system or structure of many parts united.
Integuments, (*in*, *tego*, L.) a covering. The word is often applied to the skin and other membranes by which the body or any part of it is covered.
Intestines, (*intestinus*, *intus*, L.) a long canal in the abdomen, forming part of the organs of digestion.
Mucilage, (*mucus*, L.) a kind of slimy ointment.
Process, (*pro*, *cedo*, L.) a protuberance, eminence, or projecting part of a bone.
Tendon, (*tendo*, L.) *Lit.* the stretcher.

THE FRAMEWORK OF THE HUMAN BODY—THE TRUNK.

THE human body is constructed upon an internal bony skeleton, which serves as a framework or scaffolding for its

support, and protects its softer and more tender organs. It may be considered as made up of six parts, the *head*, the *trunk*, and the four *limbs*.

The head is chiefly occupied by the brain and the organs of sense. The former is lodged in the *skull*, a strong hollow cup composed of eight bones, which, having their edges curiously notched, like the teeth of a saw, fit firmly and compactly into each other. The receptacle so formed is attached to the top of the spine, and thus the brain is put in immediate connection with the spinal cord, which closely resembles it in nature and functions.

In thus fixing the head upon the spine, careful provision had to be made for its necessary motions. Man's nature leads him to look upwards, but he could have never done so, had his neck been rigid. And even to look downwards, or to either side of him, would have been in that case an awkward and troublesome process. Yet how easily do we accomplish all these movements! Two separate joints, quite different in construction, are introduced to give us the required freedom. First, between the head and the uppermost vertebra of the neck, there is a joint somewhat like a hinge, which we use when we nod, or stoop, or look upwards. But this is not enough; we must also have the power of turning the head round upon the body to a certain extent. Accordingly, in the uppermost vertebra of the neck, already spoken of, there is a hole or socket, into which is inserted a small tooth-like projection (called by anatomists a *process*) on the vertebra next below it. Round this process, as on a pivot or axle, the uppermost vertebra turns in a circle, carrying the head along with it, as far as the attached muscles will permit. Thus are both motions perfect, without in the least interfering with each other.

The spine itself is a miracle of creative skill. What a number of purposes it serves! It must be flexible, yet firm, that the body it supports may have the power of bending, and also the power of maintaining an erect position. It must furnish a pipe for the lodgment and protection of the spinal cord, one of the most delicate substances

in the whole animal frame. And, what appears still more difficult of attainment, the continuity of that pipe must not be broken, nor any undue pressure exerted on its precious contents, when the body is moved, or bent, or twisted. A series of loopholes is also required through which the spinal cord may send out nerves to all parts of the body. Still further, the same spine must afford a fulcrum, stay, or basis, for the action of the muscles which are spread over the trunk, and also a support for the ends of the ribs to rest upon. All these purposes are admirably provided for by a column of vertebræ. Each vertebra consists (fig. 19) of a

FIG. 19.

disc or flat piece of bone (*a*), with surfaces nearly parallel, several processes (*b*, *c*, *d*), an aperture, or short canal (*e*), for the spinal cord, and notches or grooves on each side for the nerves to pass through. The processes of the different vertebræ fit into each other, and they are fastened together by cartilages of great strength, flexibility, and elasticity. The structure is then one of the most perfect that can well be conceived. The breadth of the bases on which the parts severally rest, and the closeness of the junction, give to the column its stability; the number of the parts, and the consequent frequency of joints, its flexibility. Again, the hole in one bone falls into a line with those in the bones adjacent to it, so that a continuous canal is formed; and the change and pressure, produced by bending the body, is divided among so many joints, and thrown to so great an extent on the elastic cartilages, that the line of this canal is not readily broken or obstructed. The notches left for the passage of the nerves also fit together two by two, and thus form a row of small holes on each side of the spine. The numerous processes of the vertebræ serve as handles for the muscles to pull by, and some of them are articulated with the ribs, the whole connection of these various parts being so artfully contrived, as to contribute materially to the most important result, the strength and stability of the compages.

The ribs are twenty-four in number, twelve on each side; they are supported at one end by the spine, and the upper seven on each side are united at the other end, by means of cartilages, to the breast-bone. Within the ribs, and protected by them, are the heart and lungs, which may be reckoned among the most important organs of the body. Below, inclosed by soft integuments, are the stomach, liver, and intestines. The trunk is completed and supported by a broad bony basin called the *pelvis*, chiefly formed by the two haunch-bones, with which the lower limbs are articulated.

THE FRAMEWORK OF THE HUMAN BODY—THE LIMBS.

The limbs are four in number, two legs and two arms. In structure, the legs and arms closely resemble each other, and the same analogy extends, in a greater or less degree, to the limbs of all vertebrate animals.

The arm is attached to a bone named the shoulder-blade. They are connected by what is called a ball-and-socket-joint, formed by a hollow cup in the shoulder-blade, into which is fitted a corresponding knob or ball on the head of the first or uppermost bone of the arm. Such a joint manifestly admits of a great variety of motions. The bone thus fitted into the shoulder-blade is a long tube, made hollow for the sake of lightness, and articulated at the elbow, by a hinge-joint, with the bones of the forearm. But here there occurs a difficulty, so to speak, in providing for the necessary motions of the forearm and hand. A moment's consideration will show that the hinge-joint admits of motion only in one plane. By using it, we can bend the arm at the elbow and extend it again, but we can do nothing more. How is it, then, that we are enabled to turn the palm of the hand either up or down? Very singular indeed is the mechanism which gives us this power. Above the elbow, the arm has but one bone; between the elbow and the wrist, it has two. These two bones are so connected as to roll upon each other, and, in doing so, they carry the hand

round with them. Other motions depend upon the connection of the numerous bones in the wrist and hand. The wrist itself contains eight, arranged in two rows or arches of four bones each. All these move more or less freely on each other, and thus lessen the shock and danger arising from the transmission of force from the hand to the arm, or from the arm to the hand. Next comes a row of five larger bones, supporting each a finger. These form the body of the hand, between the fingers and the wrist. Last of all, connected by hinge-joints, are the finger-bones, of which the thumb has two, and each of the four fingers three.

It is not difficult to trace the similarity between the structure just described and that of the lower extremities. Into the haunch-bone, forming part of the pelvis, the thigh-bone is inserted by a ball-and-socket-joint, just as the first bone of the arm is inserted into the shoulder-blade. The thigh-bone is round and hollow, and extends to the knee, being by far the longest, as well as the strongest bone in the body. The knee is a hinge-joint like the elbow. In the leg are two bones, rolling upon each other in the same manner and for the same purposes as in the fore-arm. Then follow two rows or arches of three and four bones respectively. These form the ankle, and correspond to the two arches already described in the wrist. In like manner, the five bones of the hand have an exact counterpart in five similar bones which form the skeleton of the foot. To complete the resemblance, the toes, like the fingers, have each a series of three bones connected by hinge-joints, except the great toe, the thumb of the foot, which has two only.

It is impossible to notice here the numerous contrivances by which every variety of limb, whether in man or in the lower animals, is adapted to its special purpose. One is too prominent to escape notice. When, as in the human body, the upper extremities assume the form of arms, a *collar-bone* (as it is called) extends from each shoulder to the top of the breast-bone. These collar-bones are intended to keep the shoulders apart, and hence the frequency of

their fracture when any sudden shock forces the arms inwards on the chest. Birds of powerful flight have the collar-bones strongly developed, whereas in horses and most other quadrupeds they are entirely awanting.

While such adaptations to particular ends are well worthy of our notice and admiration, it is probably in the joints that we see the wisdom and goodness of the Creator most strikingly displayed. Every one of them is of the kind which best suits its particular place. The greatest care has also been taken to make them work smoothly and easily, as well as in convenient directions. The hard bones are not allowed to grate harshly upon each other, but have their surfaces coated with a soft and elastic cartilage, by which the friction is greatly lessened. Still further to provide against the irritation likely to result from frequent and long continued motion, each joint is regularly supplied with a mucilage, more emollient and slippery than oil itself, which lubricates the surfaces in contact, and renders their motion easy and pleasant. This mucilage is secreted by a membrane forming part of the joint itself, and supplied as the necessities of the joint demand. Man, it is true, has contrived to make some of his machines regulate their own supply of oil, but his utmost skill has failed to attain the perfection here shown by the Creator's handiwork, in which the supply is not only regulated, but *produced.*

THE MUSCLES.

It is not enough that the skeleton be skilfully constructed, and jointed together with consummate art. Motion would not follow of its own accord. It will not suffice that the bones be made capable of moving, they must actually be moved. There must be some power to pull the machinery, which has been so carefully fitted for being pulled. This is exactly what the *muscles* supply. They are the *active,* as the bones and joints are the *passive,* apparatus of motion.

The muscles constitute what is usually known as the red

flesh of the body. They are composed of bundles of fibres, which possess the singular property of *contractility*, that is, of contracting or shortening themselves under excitement. Each muscle is attached to two or more bones, some of which must be moved by its contraction. We may easily observe this process in several parts of the body; as, for example, in the forearm, when the fingers are alternately bent and extended.

It often happens that a muscle cannot be conveniently accommodated in the exact position where it is required. It is accordingly placed in some convenient situation, and attached by a string, called a *tendon*, to the bone which it is intended to move. This tendon is simply a rope for the muscle to pull by, and may be longer or shorter according to the necessities of the case. The hand furnishes a good example. If the muscles which move the fingers had been placed in the palm, or back of the hand, they would have swelled that part to an awkward and clumsy shape. They are, therefore, placed in the forearm, and act by long tendons, strapped down at the wrist, and passing through the hand to the fingers, and to those joints of the fingers which they are severally intended to move. In like manner, the muscles which move the toes and other joints of the foot, are conveniently, not to say gracefully, disposed in the calf of the leg. Sometimes, again, it is necessary to change the direction of the motion which the contraction of a muscle produces. This is managed by some of the very same means which man employs for the same purpose. The tendons are passed over protuberances on the bones, from which they proceed in any direction that may be desired. Where no bone is available, the same end is attained by a strap or ligament. Thus the tendons which pass from the leg to the upper part of the foot are bound down at the ankle by a strong ligament, which both prevents them from starting, and changes the direction of the force which they convey.

A muscle acts only by contraction. Its power is exerted in no other way. Hence, it follows that the same muscle

cannot pull a bone in two opposite directions; if, for example, it bends the arm, it cannot also extend it. For this latter purpose a second muscle is required. The same thing obtains in all the limbs, and in every movable part of the body. Not a finger can be bent and straightened without the contraction of two antagonistic muscles. We, therefore, find that most of the muscles are arranged in opposing groups, which pull against each other like sawyers in a pit. Not only the faculty of motion, but even the symmetry of the body is preserved by this opposition. The mouth is kept in the middle of the face by two sets of muscles drawing against and balancing each other, and when, from disease or accident, one of them becomes powerless, the other, having nothing to counteract its influence, draws the mouth awry.

We can never sufficiently admire the variety, quickness, and precision of which muscular motion is capable. Let any one observe his own hand while he is writing, and notice how many different muscles must be brought to bear upon the pen. The joint and accurately adjusted operation of several tendons is concerned in every stroke, yet, by a rapid writer, many hundreds of these strokes are drawn in a minute. Not a letter can be formed without more than one, or two, or three separate contractions, each of them definite both as to the choice of the muscle, and the extent of its exertion. Yet how easily, how currently does the work proceed! And, when we look at the result, how faithful have the muscles been to their duty, how true to the order which endeavour or habit has inculcated!

QUESTIONS FOR EXAMINATION.

Of what use is the skeleton? How are the bones of the skull joined? Why is the skull connected with the back-bone? What joint enables us to nod? to turn the head round? Where are they respectively situated? How do they differ? What purposes are served by the spine? Describe a vertebra. What gives the spine its flexibility? its stability? Where are the ribs? the breast-bone? the pelvis? With what bone are the arms articulated? Why are there two bones in the forearm? Why so many in the wrist? How does the shoulder-joint differ from the elbow? What sort of joints have the fingers? Show that the skeletons of the leg and arm are similarly constructed. Where is the collar-bone? Of what use is it? What means are taken to lessen the friction

of the joints? Of what use are the muscles? What peculiar property have they? What are *tendons?* Why are they necessary? How is the direction of their motion changed? Give examples. How are two opposite motions provided for? Give an example of the celerity and exactness of muscular action.

THE WAY OF THE WIND.

It is scarcely necessary to remark that wind is nothing but the air in motion. We may learn our first lesson respecting it from the breezes that are frequently noticed on the shores of our own country in the hot summer weather, and which occur with greater constancy in tropical climates. Many of us may have observed how a cool sea-breeze sets in during the day, and a warmer land-breeze begins to blow shortly after sunset. The cause of this is easily explained. The land absorbs the heat from the sun to a much greater extent than the water does, and becoming thus hotter, it naturally causes the air above it to be warmer than that which overlies the sea. Now, air expands by heat, as other things do, and thus becomes lighter, and ascends, its place being supplied by colder air, which, in the instance before us, must come from the sea, thus forming the refreshing sea-breeze which moderates the heat of the summer noon. But at night the reverse is the case. The land cools much more rapidly than the water, so, after a while, it becomes actually the colder of the two, and the breeze now sets from the land to the sea. It will be evident, that when the air is sweeping along near the surface of the earth from the ocean to the shore, the space it is leaving must be filled from elsewhere, and what so ready to fill it as the air which has just risen from the heated ground. Accordingly, we always find that when there is a wind of this sort blowing in one direction, there is a contrary current in the upper regions of the atmosphere.

From this we may learn what is constantly taking place on a grand scale over the whole surface of the globe. The great heat near the equator causes a constant upward current which draws the air from those regions that are

colder. Hence there are two gigantic circles of wind, one in each hemisphere: the air rising, passing through the upper parts of the atmosphere, descending as it nears the poles, and then sweeping again over the surface of the earth towards the equator. But there are several things which interfere with the regularity of this action. In the first place, this globe of ours is always revolving rapidly from west to east; and although this would not affect air when at rest, or blowing around the same latitude, yet it must be remembered that the air starting from the equator has a more considerable impetus than is necessary to accompany the earth in its rotation in higher latitudes; and hence the stream which blew at first from the south, appears presently to be coming from the south-west; and when it arrives near the pole, it will have become almost a due west wind. The reverse takes place with the stream from the north, for the opposite reason, it is soon found to be blowing from the east of north, and eventually changes in like manner into a regular east wind.

Again, the configuration of the land, the direction of mountain-chains, local alternations in the temperature of the earth, and a thousand other circumstances, are always interfering, and thus render the problem of the winds an extremely difficult one. The wind, too, meets with resistance in passing near the earth, and thus flows less quickly than it does in the higher regions, just as the water at the bottom and sides of a river never has so great a velocity as that in the middle of the stream.

This great circle above mentioned, between the poles and the equator, is observed in the trade-winds, which blow steadily from the eastward on each side of the "region of calms" that marks the hottest part of the earth's circumference. The returning "trade" in those latitudes is at such a height above the ground that it is only indicated by light films of cloud, which are often seen to move in the opposite direction to the prevailing current below. In our own climate the upper stream frequently descends, and, as a south-west wind, brings to us some of the warmth and

moisture of the tropics; though, perhaps, we more frequently experience the lower current—the north-east wind, which will often blow steadily for weeks together, especially in spring, brings us cold from the pole and the frozen plains of Russia.

When two currents, blowing from opposite directions, meet, they must slide, as it were, past one another, but at their junction a whirlwind will be produced, such as we have often seen on a small scale in the eddies caused by a house, or some such opposing body. We all know how such little whirlwinds catch up dust or straws into the air, or sometimes play strange pranks with the dress of the unwary traveller; and we can readily understand how, when a larger vortex than these is sweeping unobstructed over the sea, the clouds above and the waters below should be caught into it, and meeting in mid-air, should form those water-spouts which are so dangerous to small vessels. The sailors are accustomed to disperse them, as they do human enemies, by firing cannon at them, and so breaking the circle of wind. The most severe storms are produced when the great south-west and north-east currents oppose one another. The gigantic whirlwind then formed may be scores of miles in breadth, and will often sweep right across the Atlantic, traverse our own country, and then pass on to Denmark and the continent of Europe. Through the great attention lately paid to the "circular theory of storms," captains of ships are enabled, by observing the direction of the change of wind, to sail right away from the danger. For instance, if sailing eastward in the northern hemisphere, he observes the wind veering from south to west, and then to north, the centre of the storm is on his right hand, and he, of course, will only have to turn his vessel towards the left, and the tempest may spend its fury harmlessly in the distance. Just in the same way the landsman may judge, by the rapid shifting of the weathercock, what is the course of a hurricane, which may be at that very moment tearing up trees, overthrowing hayricks, and unroofing houses.

Thus, however much we may have been accustomed to

view the wind as an emblem of all that is fickle and capricious, we now see that, whether it be a West-Indian tornado, at the speed of seventy miles an hour, devastating whole islands, or a gentle breeze, which scarcely stirs the petals of a flower, it is as subject to fixed and regular laws, and as much a matter of scientific investigation, as the growth of a tree, or the course of a planet.

J. H. GLADSTONE.

THE CLOUD.

[PERCY BYSSHE SHELLEY, the eldest son of Sir Timothy Shelley, was born in Sussex in 1792. He was sent to Eton, whence, owing to his eccentricity of character, he was removed to Oxford, much before the usual period. Here a repetition of youthful irregularity, deeply aggravated by the open avowal of his atheistical opinions, caused his expulsion, and an imprudent early marriage cast him off from his family. In search of health he repaired to Switzerland, and thence to Italy. He was drowned in the Gulf of Spezzia in 1822. His principal poetical works are "Prometheus Chained," "Alastor or the Spirit of Solitude," "Queen Mab," and "Cenci."]

I bring fresh shòwers for the thirsting flówers,
  From the séas and the strèams;
I bear light shádes for the lèaves| when láid
  In their noon-day drèams;
From my wings are shàken| the dews that wáken
  The sweet bírds| every òne,
When rocked to rèst| on their mother's bréast,
  As she dánces about the sùn;
I wield the flàil of the lashing háil,
  And whíten the green plains ùnder;
And then agàin I dissolve it in ráin,
  And láugh| as I pass in thùnder.

I sift the snòw on the mountains belów,
  And their great pínes| groan aghàst;
And all the nìght| 'tis my pillow whíte,
  While I sléep| in the arms of the blàst.
Sublime on the towers of my skyey bówers,
  Líghtning, my pìlot, sits;

In a cavern ùnder| is fettered the thúnder—
  It strùggles and hówls by fìts;
Over éarth and òcean, with gentle mótion,
  This pìlot is guiding mé,
Lured by the lòve| of the genii that móve
  In the dépths of the purple sèa;
Over the rìlls, and the cràgs, and the hílls,
  Over the lákes and the plàins,
Wherever he drèam, under mountain or stréam,
  The spirit he lóves| remàins;
And I, all the while, bask in heaven's blue smíle,
  Whilst hé is dissolving in ràins.

The sanguine sùnrise, with his meteor éyes,
  And his burning plumes outspréad,
Leaps on the back of my sailing ráck,
  When the morning stár| shines dèad;
As on the jag of a mountain crág,
  Which an earthquake ròcks and swíngs,
An éagle alìt, one moment may sít,
  In the líght of its golden wìngs.
And when sunset may brèathe, from the lit sea benéath,
  Its ardours of rest and lòve,
And the crimson pall of eve| may fall
  From the depth of heaven abóve,
With wings folded I rèst, on mine airy nést,
  As stíll| as a brooding dòve.

That orbed màiden, with white fire láden,
  Whom mortals call the móon,
Glides glimmering o'er my flèece-like flóor,
  By the midnight brèezes strewn;
And wherever the beat of her unseen féet,
  Which only the àngels hear,
May have broken the woof of my tent's thin róof,
  The stars peep behínd her| and pèer;
And I làugh to see them whìrl and flée,
  Like a swárm of golden bèes,

When I widen the rènt| in my wind-built tént,
  Till the calm rìvers, làkes, and séas,
Like strips of the skỳ| fallen through me on hígh,
  Are éach| paved with the móon and thèse.

I bind the sun's thròne| with a burning zóne,
  And the móon's| with a girdle of pèarl;
The volcanoes are dìm, and the stars reel and swím,
  When the whírlwinds my banners unfùrl.
From cápe to càpe, with a bridge-like shápe,
  Over a torrent séa,
Sùn-beam proof, I hang like a róof,
  The móuntains its còlumns be.
The triumphal àrch| through which I márch
  With hùrricane, fìre, and snów,
When the powers of the àir| are chained to my cháir,
  Is the million-coloured bòw;
The sphere-fire abòve| its soft colours wóve,
  While the moist éarth| was laughing belòw.

I am the dàughter of earth and wáter,
  And the núrsling of the skỳ;
I pass through the póres of the ocean and shòres;
  I chánge, but I cannot dìe.
For after the ràin, when, with never a stain,
  The pavilion of heaven is báre,
And the wínds and sùn-beams| with their convex gléams,
  Build up the blue dome of áir,
I silently láugh at my own cènotaph,
  And out of the caverns of ráin,
Like a child from the wòmb, like a ghost from the tómb,
  I aríse| and build it agàin.

SHELLEY.

TRUTH AND FALSEHOOD.

ONE reason why truth should be spoken is, that the knowledge which any one person can have from the use of his

own senses, in many things which it most materially concerns him to know, is very limited. He must therefore often depend for his knowledge on what others say to him; and when the thing spoken of is exclusively known to the party speaking, the other must rely entirely on what he says. If, therefore, it be considered how great a part of the most serious concerns in life proceed on declarations made by one person to another, we may readily conceive, that, if these could not be relied on, the affairs of mankind would be greatly embarrassed, and confidence in each other would be destroyed. As this matter of speaking the truth is one which concerns all persons, so all persons agree in holding liars in contempt. Even the very lowest persons consider themselves to be disgraced when charged with the guilt of lying. They can endure charges which would subject them to public punishment with more composure than they can endure this. A lie is always understood to be resorted to, to secure some advantage, or prevent some evil to the person who resorts to it; or to occasion some disadvantage or injury to the person to whom, or of whom, the lie is told; sometimes both these purposes concur. The object in view is always an immoral one, and the means used are always regarded as disgraceful. It is at once obvious that wilful falsehood is forbidden by natural law, which is intended to regulate our social relations, and is expressly forbidden by divine law, which condemns all acts of fraud and deceit, and commands us to "do to others as we would have them to do to us."

It is a rare occurrence that any one who descends to falsehood succeeds in the object which he may have in view. He is commonly detected, and, if not, is suspected, which may operate quite as much to his disadvantage. If he should escape detection and suspicion, he lives in constant fear of both. He has a very troublesome secret to keep. If he should be able to do this, still he cannot hide it from himself that he is a liar; and such a person, by natural justice, is compelled to pass that sentence upon himself, which he knows that others would pass upon him

if they were as well informed as he is. A liar is therefore obliged to feel like a guilty person, and a habitual liar very soon comes to look like one. If there be no higher motive than one's own interest and welfare in speaking the truth and avoiding falsehood, this is a very sufficient one. If a man is known to be a person unworthy of confidence when he speaks, he has not the benefit of being credited even when he speaks the truth; he voluntarily deprives himself of the advantages of social life; his assertions secure to him no credit; his promises are contemned; he makes himself to be alone in the very bosom of society, for every one shuns him. In the administration of justice in courts, a person is not regarded as a witness, whose common reputation is that he is not believed when he speaks. The objection to him is not that he might not tell the truth in the matter which is on trial, but that such a person ought not to be received as a witness, because he cannot be credited in anything that he says. When such a person has been called and examined as a witness, it is usual to examine other witnesses to prove his character; and if it be proved that he is unworthy of credit, what he has sworn to is disregarded, though he may have declared the truth. This is the common fate of all such unfortunate persons in society, as well as in courts. Independently of the criminality, lying is very poor policy. If the object be to obtain a supposed good, it rarely is obtained by such means; and if it be, the price so paid must always be greater than the good is worth. If the object be to conceal a wrong done, it is rarely successful; and if not, it leaves the offender without excuse for his error, and adds another wrong. If the object be to charge an innocent person with a wrongful act, or to deprive one of his good name, or of some lawful possession, or subject him to some evil which he ought not to endure, the offence is of that cast which the law of the land holds to be *malicious*, and it deals with such offence accordingly. In short, it is very difficult to violate any law of natural justice or divine prohibition without encountering an adequate punishment; and it may be assumed that the

punishment which follows lying is as certain and just as in any instance of criminality. If every tenant of every prison, and every person who is in the custody of a goading conscience, were asked this question, *What was your first step from innocence and purity?* he would probably answer, *Telling a lie!*

SULLIVAN.

THE HOUR OF DEATH.

Lèaves| have their time to fáll,
And flòwers| to wither at the north-wind's bréath,
And stárs| to sèt—but àll,
Thóu hast àll seasons for thine ówn, O Dèath!

Dáy| is for mortal càre,
E've| for glad meetings round the joyous hèarth,
Níght| for the dreams of sléep, the voice of pràyer;
But àll for thée, thou míghtiest of the èarth!

Yoùth and the opening róse|
May look like thíngs too glòrious for decáy,
And smìle at thee! but thou art not of thóse
That wait the ripened blòom| to seize their prey!

We know| when mòons shall wáne,
When súmmer birds from fár| shall cross the sèa,
When autumn's hùe| shall tinge the golden gráin;
But whò shall téach us| when to look for thèe?

Ìs it| when spring's first gale
Comes forth to whisper where the violets líe?
Ìs it| when roses in our paths grow pále?
They have *óne* season—*àll* are ours to die!

Thóu art| where billows fòam,
Thóu art| where músic melts upon the àir,
Thóu art aroùnd us| in our peaceful hóme,
And the wórld calls us forth—and thóu art thère;

Thóu art' where friend meets friénd,
Beneath the shadows of the elm to rèst;
Thóu art' where fóe meets fòe, and trumpets rend
The skíes, and swórds' beat down the princely crèst.

Lèaves' have their time to fáll,
And flòwers' to wither at the north-wind's bréath,
And stárs' to sèt—but àll,
Thou hast *àll* seasons for thine ówn, O Dèath!

MRS. HEMANS.

THE NERVOUS SYSTEM.

Anterior, (L., from *ante*) fore, before in time or place.
Camera obscura, (L.) *Lit.*, a dark chamber. The name is applied to an optical instrument consisting of a dark chamber into which light is admitted through a convex lens, so as to fall upon a screen behind it, and produce there a picture or image of external objects.
Choroid, (*chorion*, *eidos*, G.)
Convolutions, (*con*, *volvo*, L.) folds, windings, twistings.
Cornea, (*cornu*, L.) *Lit.*, horny.
Crystalline, (*crystallos*, G.) clear, resembling crystal.
Ganglion, (G. Pl. *ganglia*,) a small mass of nervous matter.
Iris, (L. and G.) *Lit.*, the rainbow.
Optic, (*optomai*, *ops*, G.) belonging to sight or vision.
Posterior, (L. from *post*) hinder, after in time or place.
Pupil, (*pupilla*, *pupa*, L.)
Retina, (*rete*, L.)
Sclerotic, (*scleros*, G.)
Sensation, (*sentio*, *sensus*, L.)

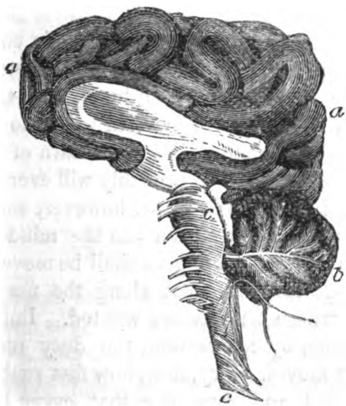
THE NERVOUS CENTRES AND THE NERVES.

THE human body, as we have learned in former lessons, is moulded upon a framework of bones, which are capable of being moved by the excitement and contraction of the muscles attached to them. It is by means of the *nervous system* that this excitement is produced, and the consequent motions regulated. The same system is also the seat of sensation, that is, of the faculties of seeing, hearing, tasting, smelling, and touching, which give us our knowledge of surrounding objects, and of those feelings, such as hunger, thirst, weariness, and the like, which make us aware of the condition of our own organs. And, still further, the same nervous system contains the organ of intelligence, and thus is connected, in some mysterious way, with the spiritual and immortal part of our nature.

There are two kinds of matter of which this nervous system is composed. First, a grey cellular substance, generally collected in masses called *centres;* and, secondly, a white fibrous substance, of which are formed, besides portions of the centres themselves, the whole of the *nerves* connecting these centres with all parts of the body. The great nervous centre of the human body is made up of the brain and spinal cord, with which the nerves of motion and sensation are connected. There are, however, smaller masses of nervous matter, known as *ganglia,* in different parts of the body. These ganglia send out nerves to the heart, liver, intestines, and other internal organs.

The brain is generally regarded as consisting of two parts, the brain proper (*a a*) (fig. 20), and the little brain (*b*).

FIG. 20.



The brain proper is divided longitudinally into two hemispheres, on the outer surface of which the grey nervous matter is arranged in folds or convolutions, as seen in the figure. These two hemispheres are united by an internal mass of the white matter of which nerves are composed. Below this are several ganglia, in immediate connection with the upper and most important part (*c c*) of the spinal cord, which, being thicker than the rest of the cord, is often called

the *bulb.* With the latter is also connected the little brain, which is situated behind, and presents in its anterior an appearance somewhat similar to the branches of a tree. It is composed of the same substances as the brain proper; and so also is the spinal cord, only in the latter the grey matter is inside, and the white outside.

Forty-three pairs of nerves proceed from the great centre which has just been described. Twelve of these pairs have their origin within the skull, and the remaining thirty-one in the spine. Each of the spinal nerves has two roots, one in the posterior, the other in the anterior part of the spinal cord. Experiment has shown that the posterior root is a nerve of sensation, the anterior a nerve of motion. The two combine together to form a compound nerve, but, at the other end, the former spread themselves over the skin, the latter terminate in the muscles.

The nerves keep up a kind of telegraphic communication between the muscles, the organs of sense, and the general surface of the body on the one hand, and the brain and spinal cord on the other. The brain seems to be the immediate residence of the mind, but the nature of their connection has ever been, and most probably will ever be, unknown to the wisest of men. We know, however, some of the results of their union. No sooner has the mind *willed* or resolved that any one of the fingers shall be moved, than there issues a message to that effect along the nerve that leads to the muscle whose services are wanted. Immediately the muscle performs, by contraction, the duty required of it, and the finger moves. Try, now, how fast such a movement can be performed, and remember that, every time a single finger wags backwards and forwards, two such messages must be forwarded and obeyed. Yet we feel no difficulty in wagging all the fingers at once, and that with great rapidity, moving at the same time the head, the arms, the legs, and the toes!

There are other motions not dependent on the will, and some have been wisely placed altogether beyond its control. For example, the heart never ceases to beat, even when we

are asleep. It would not be well for us if its motion were under our management or dependent on our care, for we should be apt to let it stop, and when it stops we die. To understand the origin of such involuntary motions, notice what happens when anything approaches too near the eye. That organ, so easily injured, has been made cautious, if the expression may be allowed, in guarding itself against danger. As soon as any object threatens to touch it, an alarm is despatched to the nervous centre, and forthwith an answer returns, in virtue of which the proper muscles contract, and the eyelid closes. An impression is telegraphed inwards, and, whether it produces a sensation or not, is followed by a message outwards, which regulates the motion to be performed.

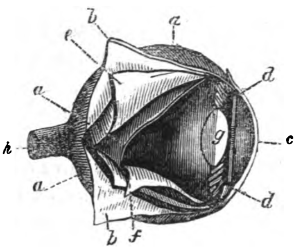
It is scarcely necessary to add that this whole subject borders on a region where much is dark and unknown. Verily "we are fearfully and wonderfully made." The mechanism itself we may examine and describe, but its union with a living and life-giving spirit, and the mode of that spirit's action upon it, are entirely beyond our comprehension.

SENSATION—THE EYE.

The brain appears to be the seat of sensation, as well as of intelligence and will. To it a vast multitude of impressions, made upon the internal or external organs, are conveyed by the connecting nerves. In the case of the external senses, of which five are usually enumerated, the organs may be said to collect, the nerves to carry, intelligence. By virtue of this varied apparatus, the mind sees, hears, tastes, smells, and feels: the particular nature of each sensation depending on the organ from which it comes, and on the object by which it is excited. Thus, snow gives us, through the eye, the sensation of whiteness; through the tongue or fingers, the sensation of cold. Salt appears similar to the eye, but has a very different effect upon the tongue.

Of the organs of sense, the *eye* is that whose construction is best understood. In a full-grown man, it is a ball or

FIG. 21.—THE EYE DISSECTED.



a a a—Sclerotic coat.
b b—Sclerotic coat turned back to show internal coverings.
c—Cornea.
d d—Iris, having an aperture in the centre, called the *pupil*, immediately in front of the crystalline lens *g*.
e—Choroid coat, turned back.
f—Retina, turned back.
g—Crystalline lens.
h—Optic nerve, connecting the retina with the brain.

globe of about nine-tenths of an inch in diameter, formed by a very dense, tough, and opaque white fibrous membrane, called the *sclerotic coat*, which surrounds and protects the internal parts. Into the front of this spherical chamber is inserted a circular transparent portion, like a very small watch-glass, which serves the purposes of a window. This part, which is nearly half an inch in diameter, is called the *cornea*. A little behind the cornea is the *iris*, a sort of circular curtain for the purpose of regulating the quantity of light to be admitted. The iris has a round hole or opening in its centre, called the *pupil*, which contracts in strong light, and expands again when the light is diminished. It is the iris that determines the colour of different eyes. It is seen through the cornea as blue, black, or brown, while the pupil appears as a black spot in the centre. Continuous with the iris, and extending backwards as an internal lining beneath the sclerotic coat, is a dark membrane, called the *choroid coat*, and within it again, like a second lining, is another membrane, called the *retina*. The retina is connected with the *optic* nerve, which, proceeding from the back part of the eyeball, connects the eye with the brain. But the most exquisite piece of mechanism in the eye has yet to be noticed. This is the *crystalline lens*, which is situated

immediately behind the pupil, and through which all the light entering the eye must pass. The cavity between this lens and the retina is filled with a transparent fluid, and so also is the smaller cavity between the lens and the cornea.

The crystalline lens is convex on both sides, and as pure and transparent as a drop of water, though it is formed of concentric folds or layers, like the coats of an onion. Whoever has seen a *camera obscura*, knows that a glass lens of similar shape will form and throw upon a screen an image of any object placed before it. This the crystalline lens, owing to its peculiar structure, does with much greater perfection. The eye, then, is just a camera obscura, in which this lens forms the image, and the retina is the screen which receives it. When the rays of light from an external object fall upon the eye, they pass readily through the transparent cornea and the fluid within it. The iris adjusts itself so as to admit the necessary quantity. The light then falls on the crystalline lens, whose construction is so marvellously perfect, that a distinct miniature image of the object looked at, though it may be an extensive landscape, is formed upside down on the retina behind. So far the process is similar to that which takes place in a camera, though neither can be fully explained here. But now a new element is introduced. The optic nerve, connected with the retina, conveys the impression to the brain, and the mind sees, not the *inverted* image, but the object itself in its true *erect* position. That there is an inverted image, however, may be proved by taking the eye of an ox, paring off the back part of the sclerotic and choroid coats, and placing the eye in a hole of a shutter, so as to look out on a landscape. If the room be sufficiently dark, the image on the retina may then be seen from behind.

We cannot fail to be struck with wonder at the correctness of these minute pictures, which are ever forming, and ever changing, in our eyes as we look around us. A landscape of several miles in extent is brought into a space whose diameter is only about half an inch, yet the multi-

tude of objects which it contains are all preserved, all discriminated in their magnitudes, positions, figures, and colours. With good reason was it said by a distinguished philosopher, that the examination of the eye is a cure for atheism. If anything can abate our admiration of the smallness of the visual tablet compared with the extent of vision, it is a reflection which the study of nature constantly forces upon us, that, in the hands of the Creator, great and little are nothing. "One day," an apostle tells us (2 Pet. iii. 8), "is with the Lord as a thousand years;" and we are fully warranted in adding, one inch is as a thousand miles. Time and space vanish in presence of Infinity.

QUESTIONS FOR EXAMINATION.

What are the functions of the nervous system? Of what substance is it composed? What parts of the body form the great nervous centre? Describe the structure of the brain. How many nerves proceed from within the skull? How many from the brain? from the spinal cord? What is peculiar about the roots of the spinal nerves? In what part of the body is the mind supposed to reside? Explain the process of voluntary motion. Give instances of involuntary motion. Where is the seat of sensation? What is the use of the organs of the senses? How large is a man's eye? Describe its structure. What is the use of the iris, the crystalline lens, and the retina? To what optical instrument is the eye similar? How may it be demonstrated that an image is formed at the back of the eye? In what respects is this image wonderful?

THE ISLAND.

If the author of the "Irish Melodies" had ever had a little isle so much his own as I have possessed, he might not have found it so sweet as the song anticipates. It has been my fortune, like Robinson Crusoe, to be thrown on such a desolate spot; and I felt so lonely, though I had a follower, that I wish *Moore* had been there. I had the honour of being in that tremendous action off Finisterre, which proved the end of the earth to many a brave fellow. I was ordered with a boarding party forcibly to enter the Santissima Trinadada; but in the act of climbing into the quarter-gallery, which, however, gave no quarter, was rebutted by the butt-end of a gun—a marine's, who remained the quarter-

master of the place. I fell senseless into the sea, and should no doubt have perished in the waters of oblivion, but for the kindness of John Monday, who picked me up to go adrift with him in one of the ship's boats. All our oars were carried away—that is to say, we did not carry away any oars; and while shot was raining, our feeble hailing was unheeded. As may be supposed, our boat was anything but the jolly-boat, for we had no provisions to spare in the middle of an immense waste. We were, in fact, adrift in the cutter, with nothing to cut. We had not even junk for junketing, and nothing but salt water, even if the wind should blow fresh. Famine, indeed, seemed to stare each of us in the face—that is, we stared at one another. We were truly in a disagreeable pickle, with oceans of brine and no beef; and I fancy we would have exchanged a pound of gold for a pound of flesh. No bread rose in the east, and in the opposite point we were equally disappointed. We could not compass a meal any how, but got meally-mouthed, notwithstanding.

Time hung heavy on our hands, for our past days seemed to pass very slowly; and our strength was rapidly sinking, from being so much afloat. Still we nourished Hope, though we had nothing to give her. But at last we lost all prospect of land, if one may say so when no land was in sight. The weather got thicker as we were getting thinner; and though we kept a sharp watch, it was a very bad look-out. We could see nothing before us but nothing to eat and drink. At last the fog cleared off, and we saw something like land right a-head; but, alas! the wind was in our teeth as well as in our stomachs. We could do nothing but "keep her near;" and as we could not keep ourselves full, we luckily suited the course of the boat, so that, after a tedious beating about—for the wind not only gives blows, but takes a great deal of beating—we came to an island. Here we landed, and our first impulse on coming to dry land was to drink. There was a little brook at hand to which we applied ourselves till it seemed actually to murmur at our inordinate thirst. Our next care was to look for some food; for though our hearts

were full at our escape, the neighbouring region was dreadfully empty. We succeeded in getting some natives out of their bed, but with difficulty got them open: a common oyster-knife would have been worth the price of a sceptre. Our next concern was to look out for a lodging, and at last we discovered an empty cave, reminding me of an old inscription at Portsmouth, "The hole of this place to let." We took the precaution of rolling some great stones to the entrance, for fear of last lodgers—lest some bear might come home from business, or a tiger to tea. Here, under the rock, we slept without rocking; and when, through the night's failing, the day broke, we saw, with the first instalment of light, that we were upon a small desert isle, now for the first time an Isle of Man.

HOOD.

THE BROOK.

[ALFRED TENNYSON was born in 1810, and was made Poet Laureate when Wordsworth died in 1850. He first published three successive volumes of miscellaneous poems, and then, latterly, the "Princess," "In Memoriam," "Maud;" and in 1859 appeared "Idylls of the King, or Romances of the Court of King Arthur." He is generally and justly esteemed the truest poet of the day; though his intellectual style of thought and feeling, and his artistic subtlety of composition, not to speak of forced conceit, vague conception, and occasional prolixity, necessarily circumscribe the circle of his readers. He can never be a popular poet: no poet of the highest order could have written his most celebrated work, "In Memoriam," a lament for a college friend (Arthur H. Hallam, the son of Hallam the historian). He sometimes leaps into the heart of a grand subject, as in the "Charge of the Light Brigade," and throughout his compositions there runs a delightful verbal melody, now bursting forth into high dramatic power, now sweetening into some beautiful lyric strain. Careful to fastidiousness in composition, he has yet, in a small compass, given us an unequalled variety of character and theme, and mingling through all we have ever and anon happy glimpses of old England, its scenery, and its life.]

I come from haunts of coot and hern,
  I make a sudden sally,
And sparkle out among the fern,
  To bicker down a valley.

By thirty hills I hurry down,
  Or slip between the ridges,
By twenty thorps, a little town,
  And half a hundred bridges.

Till last by Philip's farm I flow
  To join the brimming river;
For men may come, and men may go,
  But I go on for ever.

I chatter over stony ways,
  In little sharps and trebles,
I bubble into eddying bays,
  I babble on the pebbles.

With many a curve my banks I fret,
  By many a field and fallow,
And many a fairy foreland set
  With willow-weed and mallow.

I chatter, chatter, as I flow
  To join the brimming river;
For men may come, and men may go,
  But I go on for ever.

I wind about, and in and out,
  With here a blossom sailing,
And here and there a lusty trout,
  And here and there a grayling,

And here and there a foamy flake
  Upon me, as I travel,
With many a silvery waterbreak
  Above the golden gravel,

And draw them all along, and flow
  To join the brimming river;
For men may come, and men may go,
  But I go on for ever.

TENNYSON.

NAPOLEON BONAPARTE.

Napóleon' understood his bùsiness. Here was a mán' who in each moment and emérgency' knew what to do nèxt. It is an immense comfort and refreshment to the spírits, not only of kíngs, but of cìtizens. Few mén' have any nèxt; they live from hand to mòuth, without plán, and are ever at the end of their lìne, and, after each áction, wait for an impulse from abròad. Napoleon had been the first man of the wórld, if his énds' had been purely pùblic. As he ís, he inspires confidence and vígour' by the extraordinary ùnity of his action.

He is fìrm, sùre, self-denýing, self-postpóning, sacrificing everything to his àim—mòney, tróops, génerals, and his own sàfety also; not misled, like cómmon adventurers, by the splendour of his own mèans. "'Incidents ought not to govern pólicy," he said, "but pólicy, ìncidents." "To be hurried away by every evént' is to have no political sýstem at àll." His víctories' were only so many dòors, and he never for a mòment lost sight of his way ónward' in the dazzle and úproar' of the present cìrcumstances. He knéw what to do, and he flew to his màrk.

He would shorten a straight líne' to come at his òbject. Horrible ànecdotes' may, no doubt, be collected from his hístory' of the prìce at which he bought his succésses; but he mùst not, therefore, be set down as crúel, but only as óne' who knew no impediment to his wìll; not blòòd-thirsty, not crúel,—but wòe to what thing or pérson' stood in his wày. "Síre, General Clarke cannot combine with General Júnot, for the dreadful fire of the Austrian bàttery." "Let him càrry the battery." "Síre, every regiment that approaches the heavy artíllery' is sàcrificed. Síre, what òrders?" *Fòrward! Fòrward!*

In the plenitude of his resóurces' every obstacle seemed to vànish. "There shall be no 'Alps," he said; and he built his perfect ròads, climbing by graded galleries their steepest précipices, until 'Italy was as open to Páris' as any tówn in Frànce. Having decíded what was to be done, he

díd that' with might and màin. He put out àll his strength. He risked éverything, and spared nòthing—neither amunìtion, nor mòney, nor tróops, nor génerals, nor himsèlf. If fìghting be the best mode of adjusting national dífferences' (as large majorities of men seem to agrée), certainly Bonaparte was ríght' in making it thòrough.

"The grand principle of wár," he said, "was, that an army ought always to be ready' by dáy and by nìght, and at all hòurs, to make all the resístance' it is càpable of making." He never economised his ammùnition, but on a hostile posítion' rained a tòrrent of iron—shèlls, bàlls, grápeshot—to annìhilate all defence. He went to the edge of his possibìlity, so heártily was he bent on his òbject. It is plàin' that in I'taly' he did what he coúld, and àll that he could; he came séveral times' within an ìnch of rúin, and his own pérson' was all but lòst. He was flúng into the marsh at Arcòla. The Austrians were betwèen him and his tróops' in the confusion of the strúggle, and he was brought off with desperate èfforts. At Lonàto,* and at óther places, he was on the point of being taken prisoner.

He fóught' síxty bàttles. He had never enoùgh. Each víctory' was a new wèapon. "My power would fàll, were I not to suppórt it by new achièvements. Cònquest' has made me what I ám, and cónquest' must maintàin me." He fèlt, with every wise mán, that as much life is needed for consërvátion' as for creàtion. We are always in pèril, always in a bad plìght, just on the edge of destrúction, and only to be sáved' by invention and coùrage. This vìgour' was guarded and témpered' by the coldest prúdence and punctuàlity. A thunderbolt in the attáck, he was found invúlnerable in his intrènchments. His very attàck' was never the inspiration of coúrage, but the result of calculàtion. His idea of the best defénce' consisted in being always the attàcking party. "My àmbition," he says, "was greát, but was of a cold nàture."

Everything depénded' on the nícety of his combinàtions; the stàrs were not more púnctual than his arìthmetic. His

* A small town near Lake Garda in Italy.

personal atténtion| descended to the smallest particulars. "At Montebéllo| I ordered Kèllermann to attack with eight hundred hórse, and with thèse he separated the six thousand Hungarian grenadiérs| before the very eýes of the Austrian càvalry. This cávalry was half a lèague off, and required a quarter of an hóur| to arrive on the field of àction; and I have obsèrved| it is always those quarters of an hóur| that decide the fate of a bàttle."

Before he fought a báttle, Bónaparte thought lìttle about what he should do in case of succéss, but a greát deal| about what he should dó| in case of a revèrse of fortune. The same prudence and good sénse| marked àll his behaviour. His instructions to his secretary at the pálace| are worth remèmbering:—"During the níght, enter my chámber| as seldom as pòssible. Do not awáke me| when you have any gòod news to communicate; with thát| there is nò hurry. But when you bring bád news, rouse me ìnstantly, for thén| there is not a mòment to be lost." His achievement of búsiness| was immènse, and enlárges the known powers of mòn. There have been many wòrking kings, from Ulýsses to William of Orange, but nóne| who accomplished a títhe of thìs man's performance.

To these gifts of náture, Napoleon added the advántage| of having been bórn| to a private and humble fòrtune. In his làter days, he had the weakness of wishing to add to his crowns and bádges| the prescription of aristòcracy; but he knew his debt to his austere educàtion, and made no secret of his contempt for the bòrn kings, and for "the hereditary dònkeys," as he cóarsely styled the Boùrbons. He said that, in their éxile, "they had léarned nothing, and forgòt nothing." Bonaparte had passed through all the degrées of military sèrvice; but, also, was cìtizen before he was émperor, and so had the key to cìtizenship. His remarks and éstimates| discovered the information and justness of the méasurement of the mìddle class.

Those who had to déal with him| found that he was not to be impósed upon, but could cípher| as well as anòther man. When the expenses of the èmpress, of his hoùse-

hold, of his pálaces, had accumulated great débts, Napoleon examined the bills of the creditors himsèlf, detected over-chàrges, érrors, and reduced the cláims| by considerable sùms. His grand wèapon, námely, the mìllions whom he dírected, he owed to the represèntative character which clothed him. He ínterests us| as he stands for Fránce and for Eùrope; and he exists as captain and kíng| only as far as the Revolùtion, or the interests of the industrious másses, found an organ and a lèader in him.

In the sòcial interests| he knew the meaning and value of lábour, and threw himself nàturally on that side. The principal works that have survíved him, are his magnificent ròads. He filled his tróops with his spìrit, and a sort of frèedom and compánionship| grew up between hìm and thém, which the forms of his cóurt| never permitted between the òfficers and himself. They performed under his éye| thát| which no òthers could do. The best document of his relation to his tróops, is the order of the dáy| on the morning of the battle of Aùsterlitz, in which Napoleon promises the tróops| that he will keep his pérson| out of reach of fìre. This declarátion, which is the revèrse of thát| òrdinarily made by generals and sovereigns on the eve of a báttle, sufficiently explains the devotion of the ármy to their lèader.

EMERSON.

NAPOLEON'S LAST REQUEST.

Ah! bury me deep in the boundless sea,
  Let my heart have a limitless grave,
For my spirit in life was as fierce and free
  As the course of the tempest wave;
And as far from the reach of mortal control
  Were the depths of my fathomless mind,
And the ebbs and the flows of my single soul
  Were tides to the rest of mankind.
Then my briny pall shall engirdle the world,
  As in life did the voice of my fame,

And each mutinous billow that skyward curls
   Shall to fancy re-echo my name:—
That name shall be storied in record sublime,
   In the uttermost corners of earth;
And renowned till the wreck of expiring time,
   Be the glorified land of my birth.
Yes, bury my heart in the boundless sea—
   It would burst from a narrower tomb;
Should less than an ocean my sepulchre oe,
   Or if wrapped in less horrible gloom.

Anon.

EVE OF WATERLOO.

Stòp! for thy tréad| is on an 'Empire's dust!
An 'Earthquake's spóil| is sépulchred belòw!
Is the spot| marked with no colossal búst?
Nor column| trophied for triumphal shów?
Nòne; but the moral's trúth| tells simpler so.
As the ground was befóre, thús| let it bè.
How that red ráin—hath made the hàrvest grow!
And is this áll| the world has gained by thee,
Thou fìrst| and lást of fields! king-making Víctory?

There was a sound of révelry| by nìght,
And Belgium's cápital| had gathered thén|
Her Beaúty and her Chìvalry; and bright
The lamps| shone o'er fair wómen| and brave mèn;
A thoùsand heárts| beat hàppily; and when
Mùsic arose| with its voluptuous swéll,
Soft eýes| looked love to eýes| which spake agàin,
And àll| went mérry| as a màrriage-bell;—
But hùsh! hàrk! a deep soúnd| strikes like a rising knèll!

Did ye not héar it? Nò; 'twas but the wind,
Or the càr| ráttling o'er the stony strèet;

O'n with the dànce ! let jóy| be unconfìned !
No sléep till mòrn, when Yoùth and Pléasure meet|
To chase the glowing hóurs| with flying fèet—
But, hàrk ! that heavy soúnd| breaks in once mòre,
As if the cloúds| its écho| would repèat;
And nèarer, clèarer, dèadlier| than before !
Àrm ! àrm ! it ís !—it is !—the cànnon's opening rōar !

Within a windowed niche| of that high hâll|
Sate Brúnswick's fated chìeftain; hé did hear
That sound the fìrst| amidst the festival,
And caught its tóne| with Déath's prophetic èar;
And when they smìled| because he deemed it néar,
Hís heart| more trùly knew that peal too wéll|
Which stretched his fàther| on a bloody biér,
And roused the véngeance| blòod alone| could quell:
He rushed into the fiéld; and, foremost| fíghting, fèll !

Ah ! thén| and there was hurrying to and fró,
And gathering téars, and tremblings of distrèss,
And chéeks| all pàle, which but an hóur ago|
Blùshed at the práise| of their own lòveliness:
And there were sudden pàrtings, such as press
The lìfe| from out young heárts, and choking síghs
Which né'er might be repèated; whò could guéss|
If ever mòre| should meet those mutual eýes,
Since upon night so swéet| such awful mòrn could rise ?

And there was mounting in hot hàste: the stèed,
The mustering squàdron, and the clattering cár,
Went pouring fòrward| with impetuous spéed,
And swiftly fórming| in the ranks of wàr;
And the deep thùnder, pèal on péal, afàr;
And néar, the beat of the alarming drúm|
Roused up the sóldier| ere the morning stàr;
While thrónged the cìtizens| with terror dúmb,
Or whispering, with white líps—"The fòe ! they còme ! they còme !"

And wìld and hígh the "Camerons' gàthering" rose!
The wár-note of Lòchiel, which Albyn's hílls
Have heard—and heárd, too, have her Sàxon foes:
Hòw in the noon of night that pibroch thrílls,
Sávage and shrìll! But with the breath which fills
Their mountain-pípe, so fill the moúntaineers
With the fierce native dáring, which instils
The stirring mémory of a thoúsand yèars;
And Èvan's, Dónald's fame, rìngs in each clansman's ears!

And Ardènnes waves abóve them her green lèaves,
Dewy with nature's téar-drops, as they pàss,
Griéving—if aught inánimate e'er grieves—
Over the unreturning bràve—alàs!
Ere évening to be trodden like the gràss,
Which nòw benéath them, but abóve shall grow
In its nèxt verdure; when this fiery mass
Of living válour, ròlling on the fóe,
And bùrning with high hópe, shall móulder cóld and lòw!

Last nóon beheld them full of lusty life,
Last éve in Beauty's círcle proudly gày;
The mídnight brought the signal sound of strìfe;
The mórn the marshalling in àrms; the dáy
Bàttle's magníficently stern arrày!
The thúnder-clouds close òer it, which, when rént,
The earth is covered thíck with óther clay,
Which her òwn clay shall cover,—hèaped and pént,
Ríder and hòrse,—frìènd, fóe,—in òne red búrial blènt!

Byron.

PART II.

SECTION IV.

WASTE AND REPAIR OF THE BODY.

Aërate, (*aër*, G.) to change by the agency of air.
Aorta, (*aortē*, G.)
Artery, (*aër*, *tereo*, G.) so called because the ancients thought that the arteries were filled with air.
Assimilated, assimilation, (*ad*, *similis*, L.)
Auricle, (*auricula*, *auris*, L.) *Lit.* the little ear.
Bile, (*bilis*, L.)
Capillaries, (*capillus*, L.) *Lit.* hair-like tubes.
Chyle, (*chylos*, *cheo*, G.)
Chyme, (*chymos*, *cheo*, G.)
Duct, (*duco*, L.) a channel.
Follicle, (*folliculus*, *follis*, L.) *Lit.* a little bag or cavity.
Gastric, (*gaster*, G.) belonging to the stomach.
Gullet, (*gula*, L.)
Lacteals, (*lac*, L.) *Lit.* the milk-like vessels.
Mucous, (*mucus*, L.) slimy; a *mucous* membrane is one which secretes a slimy substance.
Pancreas, (*pas*, *creas*, G.) *Lit.* all fleshy. The name is given to a large gland below the stomach, called also the sweat-bread. Hence *pancreatic*.
Saliva, (L.) the spittle.
Veins, (*vena*, L.)
Ventricle, (*ventriculus*, *venter*, L.) *Lit.* the little belly.

DIGESTION.

It is a peculiar excellence of the organic machinery of living creatures, that it keeps itself in repair. The living fabric, in the very actions which constitute its life, is every moment yielding up its particles to destruction, like the coal which is burned in the furnace; so much coal to so much heat, so much waste of the tissues of the body to so much vital activity. You cannot wink your eye, move your finger, or think a thought, but some minute particle of your substance must be sacrificed in doing so.

This unceasing waste implies a necessity for equally constant repair, and the materials of that repair must come from without. Unless the coal which is burning be from

time to time replaced, the fire soon smoulders, and finally goes out; unless the substance of your body which is ever wasting, be from time to time furnished with fresh food, life flickers, and at length becomes extinct. Food, then, is intended to repair the body's never-ceasing waste; it is the coal which feeds the flame of life. It is derived from without, from the animal and vegetable creation around us; and, entering the body by the mouth, is transformed and *assimilated*, that is, changed into the same substances, bone, muscle, nerve, &c., of which the body is itself composed.

The digestion of the food, which is preparatory to its being thus assimilated, commences in the mouth. There a somewhat complicated action takes place. The tongue, cheeks, and jaws, by means of their numerous muscles, roll the food about in the mouth, and keep it between the teeth, which act as a mill to tear and grind it. Meanwhile, it is moistened by the *saliva*, a tasteless fluid, manufactured by six very small bags or pouches, called *glands*, situated in the *mucous* membrane which lines the mouth. The saliva, besides moistening the food, has also a chemical effect of great importance to digestion. Food swallowed without proper mastication may no doubt be digested by a vigorous stomach, but there is just as little doubt that the duties of the latter organ are greatly, perhaps unsafely, increased, when due time is not allowed for the action of the saliva. Hence our meals should not be eaten too hurriedly.

The contents of the mouth are carried to the stomach by a pipe called the *gullet*, which extends from the back of the mouth downwards through the neck and body. Great care is taken, by means of valves or lids, to prevent the smallest morsel of the masses so swallowed from entering the windpipe, or any of the other tubes that open into the cavity behind the mouth. Every one knows that, when such an accident does happen, it is exceedingly disagreeable, and, if not speedily remedied, may be fatal.

As soon as the food enters the stomach, it is subjected to new processes, similar in some degree to those which it has already undergone. The stomach is a large pouch, resem-

bling in shape the wind-bag of a bagpipe. It is lined, like the mouth, with a mucous membrane, soft as velvet, which is studded all over with minute finger-like glands, called *follicles*. From these is poured into the cavity of the stomach, at the rate of about thirty pounds daily in a healthy man, the *gastric juice*, a fluid which may be regarded as the chief agent in digestion. This juice mingles with the food, upon which it acts chemically, gradually reducing it to a liquid or soluble state. Meanwhile the whole mass is turned round and round, by the contractions of a muscular coating which surrounds the stomach, immediately beneath the mucous lining already mentioned. By this *churning*, as it has been happily called, the solid parts are not only well ground, but thoroughly mixed with the gastric juice.

The food is now reduced to a thin pulp, but the process of its digestion is not yet complete. It leaves the stomach as *chyme*, and enters the *intestines*. Though usually spoken of as consisting of several parts, the intestines really form one continuous tube or canal, above thirty feet in length, or nearly six times the length of the body. It is coiled up, like a huge serpent, in the abdomen. The chyme, as it traverses this canal, meets with three new liquids, which greatly alter its character. These are the *bile*, formed by the liver, the *pancreatic* juice, which comes from the *pancreas*, or sweet-bread, and the *intestinal juice*, the product of certain glands in the lining of the intestine itself. By the action of these various substances, the chyme, or at least all that is nutritious in it, is gradually converted, in its progress through the folds of the intestine, into a milk-like substance called *chyle*.

Another process now commences. The chyle, thus gradually formed in the intestine, is sucked up by an immense number of minute vessels or tubes, into which it penetrates, by oozing or soaking through the walls of the intestine. Some substances, such as water, may be absorbed in the stomach itself, but these are exceptional. Absorption usually takes place in the intestine. The absorbent vessels are named *lacteals*, from their colour when filled with chyle.

They gradually unite into larger tubes, which, after passing through a series of glands, pour their contents into a common pipe or *duct*, about the size of a quill. This duct runs nearly parallel with the gullet. The chyle accordingly returns in a direction opposite to that pursued by the food before digestion, until it is poured into one of the veins of the neck, where it mingles with and replenishes the blood.

The purpose of digestion, then, is to make blood, and by the blood the waste of the body is repaired. Both mind and body must suffer if this important process is ill performed. The food should be wholesome and sufficient in quantity, but over-eating merely burdens the stomach, and retards its action. Above all, *exercise* is essential to a continuance of healthy digestion. It causes waste, and waste invites as well as gives room for repair. Besides this, exercise stimulates the organs in various ways, and is altogether one of the surest means of securing and maintaining that healthy condition of the body, which is so closely connected with a cheerful and contented mind. Viewed in this light, labour is not a curse; when it is not of a hurtful kind, nor too severe, it is blessed as well as honourable.

CIRCULATION OF THE BLOOD.

The blood is a mighty river of life. As long as life itself lasts it is impetuously rushing through every part of our bodies, by means of an elaborate network of canals. It issues from the heart, bright and red, through one great artery, named the *aorta*, which branches and branches like the boughs of a tree, the vessels becoming smaller and smaller as they divide, till at last they are invisible to the naked eye. They are then no longer called arteries, but *capillaries*. Through the walls of these microscopic tubes, with which the whole body is crowded, the blood may be

said to hold communication with the tissues composing the various organs. The tissues are gradually wasting away, consumed by the vital action of the organs which they form. But the blood comes to their aid, and out of some forty substances which it carries about in its ceaseless flow, each tissue has the power of appropriating and converting into a part of itself whatever is necessary for its repair. This is the process of *assimilation*.

But the blood does more. It not only supplies the new material, but carries away the old. It not only brings fuel to feed the flame of life, but removes the ashes which that flame has left. Having thus exchanged its glowing red for a much darker hue, it now leaves the capillaries, and enters the veins. In general form, these are similar to the arteries; only the blood flows through them in an opposite direction. It is gathered up first by the smallest branches, along which it flows till they gradually unite, and pour the whole by a single stream into one of the cavities of the heart.

But this blood has no longer any life-giving power, and before it be sent out again to the tissues, some means must be found to purify it. Its impurities have mostly assumed the form of carbonic acid, which must be exchanged for oxygen before it can become again the supporter of life. The air is an inexhaustible reservoir of oxygen, which forms, indeed, about a fifth of the whole atmosphere; but how is that oxygen to be brought into contact with the polluted blood? To accomplish this is the object of the lungs, it is for this that we are made to breathe. The heart again expels the blood, but this time by a different channel. The arteries which now convey it spread themselves over the lungs, exactly as those formerly mentioned did over the body. Meanwhile another process is going on. By a muscular effort the chest is dilated, and the air rushes in through the mouth or nostrils, and thence along the wind-pipe, to fill up the vacuum. The wind-pipe sends out branches over the lungs, like those of the arteries, and these terminate in minute air-vessels, which are interspersed among the capillaries containing the blood. Through the

delicate sides of their respective vessels, the blood receives a supply of oxygen from the air, and the air in its turn carries off the carbonic acid and other deleterious substances from the blood. The result is that the blood resumes its bright colour and life-giving energy, and returns to the heart to recommence its journey over the body.

At every breathing, a portion of the air in the lungs, laden with carbonic acid, is expelled by a contraction of the chest. Another supply is then drawn in as before, and so on, the same processes being repeated. But if the air inhaled is itself impure, the whole contents of the lungs must soon become vitiated, and the blood will return to the heart unpurified. Hence the necessity for a constant supply of pure air. None of the conditions of health is so sadly neglected as this is. Pigsties and dunghills are kept close to crowded dwelling-houses; streets are allowed to remain covered with dust and filth; houses are too often damp, ill-ventilated, and unswept; schools and churches are kept as close as if it were wrong to admit the pure air of heaven, or allow the carbonic acid breathed from hundreds of lungs to escape. No mistake could be more dangerous, none is more fatal. Of the importance of the air we breathe some idea may be formed from the wonderful fact, that in the course of a single year, an ordinary man draws in and expels 100,000 cubic feet, by means of something like 9,000,000 of separate muscular efforts, to aërate and purify some 3500 tons of blood!

The heart is the centre of the organs of circulation, the engine that sets the current in motion. It is a muscular body, consisting of four chambers or cavities, each of which has the power of contracting so as to empty itself of its liquid contents. The two principal cavities are called *ventricles;* their office is to despatch the blood through the arteries. Into the ventricles it is poured by the *auricles,* each of which is a sort of ante-chamber to its corresponding ventricle, intended to receive the blood from the veins. Hence the action of the heart is somewhat complicated. The blood, on returning from the lungs, passes into the

left auricle, whence it flows into the *left* ventricle. By the contraction of the latter it is forced through the aorta to all parts of the body. Again collected by the veins, it is received by the *right* auricle, which discharges it into the *right* ventricle. Thence it is sent out to the lungs, and, after being purified, returns again to the left auricle, to pursue, without ceasing, the same unvarying course. It is kept in its proper path by a series of valves, which open freely in one direction, but effectually prevent any return current in the other. And this process is repeated, while life continues, from 70 to 80 times in a minute. At a few points in its course, as in the wrist, the arterial current may be felt; and the beating of the heart may not only be felt, but also occasionally heard. If, however, we could for a few moments see with the bodily eye into the human frame, as with the microscope we see into the transparent frames of some of the simpler animals, a scene would be unveiled which would transcend our utmost imaginings, and which we cannot contemplate, even in thought, without a thrill. It is truly well for us that we "live, and move, and have our being," in One who is wiser and mightier than we.

QUESTIONS FOR EXAMINATION.

What causes waste in the body, and how is it repaired? What is meant by assimilation? Where does digestion commence? What process does the food undergo in the mouth? How is it conveyed to the stomach? Describe the stomach and its action. Whence comes the gastric juice? the bile? the pancreatic juice? In what form does the food leave the stomach? In what form is it absorbed? and how? How is it conveyed to the blood? What is the use of the blood? What vessels convey it from the heart? Describe them. Where does it come into contact with the tissues? with the air? What is the use of respiration? Why is pure air necessary? What vessels convey the blood back to the heart? Describe the heart itself, and its action. How often does it beat? Is the circulation of the blood perceptible by the senses, and how?

THE HOPE OF HEAVEN.

What is èarthly rest or relaxátion, whát| that release from tòil| after which we so often sígh, but the faint shádow| of the sáints' everlàsting rest—the repóse of eternal pùrity—the calm of a spírit| in which, not the tension of lábour only, but the strain of the moral strife with sìn, has céased—the rest of the sóul in Gòd! What visions of èarthly bliss| can éver—if our Christian faith be not a fórm—compare with "the glóry| soon to be revèaled?" What joy of èarthly reunion| with the ràpture of that hóur| when the heavens shall yield our absent Lord to our embráce, to be párted from us| no more for èver? And if all thís| be not a dream and a fáncy, but most sober trúth, whàt is there to except this joyful hópe from that làw| to which, in all óther deep joys, our minds are sùbject? Why máy we not in thìs case, too, think often, amidst our worldly wórk, of the home to which we are gòing, of the true and loving heart that béats for us, and of the sweet and joyous wélcome| that awàits us there? And even when we máke them not, of set pùrpose, the subject of our thóughts, ìs there not enough of grandeur in the objects of a believer's hópe| to pervade his spirit at àll times| with a calm and reverential jóy?

Dò not think all thís| strànge, fanàtical, impóssible. If it dó seem so, it can ònly be| because your heart is in the éarthly hopes, but not in the hígher and hòlier hopes—because love to Chríst| is still to you but a nàme—because you can give mòre ardour of thought| to the anticipation of a coming hóliday, than to the hope of héaven and glory everlàsting. Nò, my friends! the strànge thing is, not that amidst the world's work| we should be able to thínk of our Home, but that we should ever be able to forgèt it, and the stránger, sádder stìll, that while the little day of life is pássing—mòrning, nòontide, évening—each stage more rapid than the làst, while to mány| the shadows are already fast lèngthening, and the declining sun wárns them| that "the night is at hànd, wherein no man can wórk," there should

be thóse amongst us! whose whole thòughts are absorbed in the business of the wórld, and to whom the reflection never occúrs! that soon they must go out into etérnity, without a friénd—without a hòme!

CAIRD.

THE DUMB CHILD.

She is my only girl,—
I asked for her as some most precious thing;
For all unfinished was love's jewelled ring
Till set with this soft pearl.
The shade that time brought forth I could not see,
So pure, so perfect, seemed the gift to be.

Oh! many a soft old tune
I used to sing into that deadened ear,
And suffered not the slightest footstep near,
Lest she might wake too soon;
And hushed her brother's laughter while she lay—
Oh, needless care—I might have let them play!

'Twas long ere I believed
That this one daughter might not speak to me;
Waited and watched, God knows how patiently,
How willingly deceived;
Vain love was long the untiring nurse of faith,
And tended hope until it starved to death!

Oh, if she could but hear
For one short hour, that I her tongue might teach
To call me *mother*, in the broken speech
That thrills the mother's ear!

Alas! those sealed lips never may be stirred,
To the deep music of that lovely word.

My heart it sorely tries,
To see her kneel with such a reverent air
Beside her brothers, at their evening prayer;
Or lift those earnest eyes
To watch our lips, as though our words she knew,
Then move her own as she were speaking too.

I've watched her looking up
To the bright wonder of an evening sky,
With such a depth of meaning in her eye,
That I could almost hope
The struggling soul would burst its binding cords,
And the long pent-up thought flow forth in words.

The song of bird and bee,
The chorus of the breezes, streams, and groves,
All the great music to which nature moves,
Are wasted melody
To her—the world of sound a tuneless void;
While even silence hath its charm destroyed.

Her face is very fair,
Her blue eye beautiful, of finest mould
Her soft white brow, o'er which, in waves of gold,
Ripples her shining hair;
Alas! this lovely temple closed must be,
For He who made it keeps the master-key.

While He the mind within
Should from earth's Babel-clamour be kept free,
E'en that his still small voice and step might be
Heard at its inner shrine,
Through that deep hush of soul, with clearer thrill?
Then should I grieve?—Oh, murmuring heart be still.

She seems to have a sense
Of quiet gladness in her noiseless play;
She hath a pleasant smile, a gentle way,
Whose voiceless eloquence
Touches all hearts, though I had once the fear
That even her father would not care for her.

Thank God! it is not so;
And when his sons are playing merrily,
She comes and leans her head upon his knee,—
Oh! at such times I know,
By the full eye, and tone subdued and mild,
How his heart yearns o'er his silent child.

Not of all gifts bereft
E'en now—how could I say she did not speak?
What real language lights her eye and cheek,
In thanks to him who left
Unto her soul yet open avenues
For joy to enter, and for love to use!

And God, in love, doth give
To her defect a beauty of its own:
And we a deeper tenderness have shown,
Through that for which we grieve;
Yet shall the seal be melted from her ear—
Yea, and *my* voice shall fill it—but not here.

When that new sense is given,
What rapture will its first experience be,
That never woke to meaner melody
Than the rich songs of heaven,
To hear the full-toned anthem swelling round,
While angels teach the ecstases of sound.

Anon.

ADVANTAGES OF STUDYING LATIN AND GREEK.

[The Rev. SYDNEY SMITH was born at Woodford in Essex. He was educated at Winchester College, and afterwards at Oxford. For half a century, he rendered himself conspicuous as a political writer, a lecturer on "Belles Lettres," a critic, and a popular preacher. During his accidental residence in Edinburgh, the "Edinburgh Review" was commenced under his auspices, but he had edited the first number only of that periodical when he removed to London. He, however, continued for many years one of the most active contributors to that celebrated organ of Whig principles. He died in 1843.]

LÀTIN and Gréek are ùseful, as they inure children to intellectual dífficulties, and make the life of a young student what it óught to be, a life of considerable làbour. We dò not, of course, méan to confine this praise exclùsively to the study of Latin and Gréek, or suppose' that òther difficulties might not be found' which it would be useful to overcóme; but though Làtin and Gréek' have this merit in còmmon with many arts and scíences, still they hàve it; and, if they do nothing élse, they at least secure a solid and vigorous applicátion' at a period of lífe' which materially influences all òther periods. To go through the grammar of òne language thóroughly, is of great úse' for the mástery of every òther grammar; because there obtáins, through àll languages, a certain análogy to each other' in their grammatical construction. Làtin and Gréek' have now mixed themselves etymológically' with àll the languages of modern Eúrope, and with nóne more than our òwn; so that it is necessary to read these two tóngues' for óther objects than themsèlves.

The áncient languages' are, as mere invèntions—as pieces of mèchanism—incomparably more beaútiful' than any of the mòdern languages of Europe; their mode of signifying time and case by terminàtions, instead of auxiliary verbs and párticles, would of itsèlf stamp their superiority. Add to thís' the cópiousness of the Grèek language, with the fàncy, hàrmony, and màjesty of its cómpounds, and there are quite suffìcient reasons' why the classics should be stúdied' for the beauties of lànguage. Compared to thém' merely as vehicles of thought and pássion, all módern languages are dùll, ill-contríved, and bàrbarous.

That a great part of the Scrìptures| have come down to us in the Gréek language| is of itsèlf a reason, if all óthers were wanting, why education should be plánned| so as to produce a supplý of Grèek scholars.

The cultivation of stýle| is very jústly made a part of education. Everything which is wrítten| is meant either to pléase| or to instrùct. The sècond object| it is difficult to efféct| without attending to the fìrst; and the cultivation of stýle| is the acquisition of those rules and literary hábits| which sagacity antìcipates, or experience shóws| to be the most effectual means of plèasing. Thòse works are the bést| which have lòngest stood the test of tíme, and pleased the greatest númber of exercised mìnds. Whatèver, therefore, our conjéctures may be, we cannot be so sùre| that the best módern writers| can afford us as good módels as the àncients; we cannot be cèrtain| that they will live through the revolutions of the wórld, and continue to please in every clìmate, under every species of góvernment, through every stage of civilizàtion. The móderns| have been well taught by their màsters; but the time is hardly yet cóme| when the necéssity for such instruction| no longer exìsts. We may stìll borrow descriptive pówer| from Tàcitus; dignified perspicúity| from Lìvy; simplícity| from Cèsar; and from Hòmer, some portion of that light and héat| which, dispersed into ten thousand chánnels, has filled the wórld| with bright ímages and illustrìous thòughts. Let the cultivator of mòdern literature| addict himself to the purest models of táste| which Frànce, Ìtaly, and E´ngland could supply, he might stíll learn from Vìrgil to be majéstic, and from Tibúllus to be tènder; he might not yèt look upon the face of nature| as Theócritus saw it, nor might he reach those springs of páthos| with which Eurìpides softened the hearts of his audience. In shòrt, it appéars to us| that there are so màny excellent reasons| why a certain nùmber of scholars should be kept up in thìs, and in every cívilized country, that we should consider èvery system of education| from which clássical education was excluded, as radically erróneous, and completely absùrd.

SYDNEY SMITH.

GREECE.

Hē| whō hāth bēnt hīm ō'er thē dēad,
Ere the fìrst day of death is fléd,
The first dàrk day of nóthingness,
The làst| of danger and distréss
(Before decay's effacing fíngers|
Have swept the lines| where beauty língers),
And marked the míld| angèlic air,
The ràpture of repose that's thére,
The fíxed, yet tènder traits| that streak
The languor of the placid chéek,
A'nd—būt fōr thāt sād shroūded eȳe,
That fíres not, wíns not, wèeps not, nów;
A'nd| but for thāt chīll, chāngeless brōw,
Where cold obstruction's ápathy
Appàls the gazing mourner's heárt,
As if to hìm| it could impart
The doom he dréads, yet dwèlls upon;
Yés, but for thèse, and these alóne,
Some móments, áye, one treacherous hòur,
He stíll might doùbt the tyrant's power;
So fàir, so càlm, so softly séaled,
The fírst, làst look| by déath revèaled!

Sùch is the áspect of this shòre;
'Tis Gréece, but lìving Greece no more!
So coldly swèet, so deadly fáir,
We stárt, for sòul is wanting there.
Hèrs| is the loveliness in déath,
That parts not quíte| with parting brèath;
But beaúty, with that fearful blóom,
That húe| which haunts it to the tòmb,
Exprèssion's lást receding rày,
A gilded hálo| hovering round decày,
The farewell beam of féeling| past awày!
Spark of that flàme, perchance of héavenly birth,
Which gléams, but wàrms no móre| its cherished èarth!

Clíme of the unforgotten bràve!
Whose lánd| from plàin to mountain-cáve
Was Frèedom's hóme, or Glóry's gràve!
Shrine of the mìghty! càn it be,
That thís| is all remains of thee?
Appròach, thou craven crouching sláve:
Sày, is not this Thermópylæ?
Thēse wāters blūe| thāt rōund yōu láve,
Oh, sèrvile offspring of the frée—
Pronoùnce what séa, what shóre is thìs?
The gúlf, the róck of Sàlamis!
These scénes, their story not unknówn,
Aríse, and make agáin your òwn;
Snatch from the àshes of your síres
The émbers of their former fìres,
And hè who in the strife expíres,
Will add to thèirs a name of féar,
That týranny| shall quàke to hear,
And leave his sóns| a hòpe, a fáme,
Théy, tòo, will rather die than shame;
For Freedom's bàttle, once begún,
Bequeathed by bleeding sire to són,
Though bàffled óft, is éver wòn.
Bear wítness, Greece, thy living pàge,
Attést it, many a deathless àge!
While kíngs, in dusky dàrkness hid,
Have left a nameless pýramid,
Thý heroes, though the general doom
Hath swept the column from their tómb,
A mìghtier monument command,
The moúntains of their native lànd!
Thère points thy muse to stranger's eýe
The graves of thóse| that cànnot die!
'Twere lóng to tèll, and sad to tráce,
Each step from spléndour to disgràce;
Enoùgh—no fòreign foe could quell
Thy sóul, till from itsèlf it fell;
Yès! sèlf-abasement| paved the wáy
To villain-bónds| and despot-swày.

BYRON.

FEELINGS AT THE GRAVES OF THOSE WE LOVE.

The grave of those we lóved—what a pláce for meditàtion! Thére it is! that we call up, in long reviéw, the whole history of vírtue and gèntleness, and the thousand endearments lávished upon us—almost unhèeded—in the daily íntercourse of ìntimacy; thére it is! that we dwell upon the tènderness, the sòlemn! áwful tenderness, of the parting scène. The bed of déath, with all its stifled grièfs—its noiseless atténdance—its múte watchful assidùities. The last testimonies of expiring lóve! The féeble, flúttering, thrílling, oh, hòw thrilling! préssure of the hànd. The last fond look of the glazing eýe, túrning upon us, even from the thrèshold of existence! The fàint, faltering áccents, struggling in déath! to give one mòre assurance of affection!

Aỳ, go to the grave of buried lóve, and thére! mèditate! Thère settle the account with thy cónscience, for every past bénefit unrequìted—every past endèarment unregárded—of that departed béing, who can nèver, néver, nèver return, to be sóothed by thy contrìtion! If thou art a chíld, and hast ever added a sòrrow to the sóul, or a fùrrow to the silvered brów of an affectionate pàrent,—if thou art a húsband, and hast ever caused the fond bósom! that ventured its whole hàppiness in thy árms, to doubt one mòment of thy kíndness, or thy trùth,—if thou art a friénd, and hast ever wronged in thòught, or wòrd, or déed, the spírit that generously confìded in thee,—if thou art a lòver, and hast ever given óne unmerited pàng! to that true heart which now lies cold and still beneath thy féet,—then be sùre! that every unkind lòok, every ungracious wòrd, every ungentle áction, will come thronging back upon thy mémory, and knocking dólefully at thy sòul; then be sùre! that thou wilt lie down, sorrowing and repentant on the gráve, and utter the unheard gróan, and pour the unavailing tèar—more dèep, more bítter, becàuse unheard, and unavailing.

Then weave thy chaplet of flówers, and strew the beauties of náture about the gràve; console thy broken spìrit, if thou cánst, with these ténder, yet fùtile tributes of regret;

but take wárning| by the bìtterness of this thy contrite affliction over the déad, and hénceforth| be more faithful and afféctionate| in the discharge of thy dúties to the lìving.

WASHINGTON IRVING.

MARK ANTONY'S ORATION OVER THE DEAD BODY OF CÆSAR.

Frìends, Ròmans, coúntrymen, lénd me your èars.
I come to bùry Cæsar, not to pràise him.
The évil that men do| lives àfter them;
The góod| is oft interred with their bònes;
Sò let it bé| with Cæsar! Nòble Brútus|
Hath tóld you| Cæsar was ambìtious:
If it wére so, it was a grievous fàult,
And grièvously| hath Cæsar ànswered it.
Hére, under leave of Brùtus| and the rést—
For Brútus| is an hònourable man,
Só are they àll, àll honourable men—
Come I to spéak| in Cæsar's fùneral.
He was my frìend, faithful and just to mé;
But Brùtus says| he was ambìtious;
And Brútus| is an hònourable man.
He hath brought many captives home to Róme,
Whose ránsoms| did the general còffers fill;
Did thís in Cæsar seem ambitious?
When| that the poor have críed, Cæsar| hath wèpt;
Ambítion| should be made of stèrner stuff;
Yet Brùtus says| he was ambìtious;
And Brútus| is an hònourable man.
You àll did see that, on the Lúpercal,
I thrice presénted him| a kingly cròwn,
Which he did thríce| refùse. Was thís ambition?
Yet Brùtus says| he was ambìtious;
And, sùre, he is an hònourable man.
I spèak not| to disprove what Brútus spoke,
But hére| I am to spéak| what I do knòw.

You àll did love him ónce; not without càuse:
Whàt cause withhólds you then| to mòurn for him?
O júdgment! thou art fled to brutish bèasts,
And mén| have lost their rèason! Bèar with me;
My heárt| is in the còffin there with Cæsar,
And I must páuse| till it come bàck to me.

* * * * * * *

If you have téars, prepáre to shed them nòw.
You àll do know this mántle; I remémber
The first time| ever Cæsar put it òn;
'Twas on a summer's évening in his tènt,
That dáy| he overcame the Nèrvii.
Lòok! in thís place| ran Càssius' dagger through;
See what a rént| the envious Càsca| made;
Through thís| the well-beloved Brùtus| stabbed;
And, as he plucked his cursed stéel away,
Màrk| how the blood of Cæsar| fòllowed it!
As rushing out of dòors, to be resólved
If Brùtus| so unkindly knócked or nò.
For Brùtus, as you knów, was Cæsar's àngel:
Jùdge, oh you góds! how déarly Cæsar lòved him!
Thís| was the most unkíndest cut of àll;
For when the noble Cæsar| saw hím stab,
Ingràtitude, more strong than tráitors' arms,
Quite vànquished him; thén| bùrst his mighty heart;
And, in his màntle| muffling up his fáce,
Even at the base of Pompey's stàtue,
Which all the while ran blóod, great Cæsar| fèll.
O, what a fall was thére, my countrymen!
Then 'I, and yoú, and àll of us, fell down;
Whilst bloody tréason| flourished òver us.
O, nòw you weep; and, I percéive| you feel
The dint of pìty; thése| are gràcious drops.
Kìnd sóuls! whát! wèep you when you but behold
Our Cæsar's vésture wounded?—look you hère!
Here is himsèlf—màrred, as you sée, by tràitors.

* * * * * * *

Gòod friends! swèet friends! let me not stir you up|
To such a sùdden flood of mútiny;
They| that have done this déed| are hònourable.
What prìvate griefs they have, alas! I knów not,
That made them dò it; they are wíse and hònourable,
And will, no doubt, with réasons ànswer you.
I còme not, friénds, to stèal away your hearts;
I am no òrator, as Brútus is,
But, as you know me áll, a pláin| blùnt mán,
That love my friènd; and thát| thèy know full wéll|
That gave me public léave| to spèak of him;
For I have neither wít, nor wórds, nor wòrth,
A′ction, nor ùtterance, nor the power of spéech,
To stir men's blòod; I′| only speak right òn.
I tell you thát| which you yoursèlves do know;
Shów you sweet Cæsar's woùnds,—pòor, póor, dùmb moúths!
And bid thèm speak for me. But were I Brùtus,
And Brutus A′ntony, there wère an Antony|
Would ruffle up your spìrits, and put a tòngue|
In every wound of Cæsar, that should móve
The *stònes* of Rome| to rise and mutiny.

SHAKSPEARE.

MATTER AND FORCE.

Atom, (*a, temno*, G.) a particle so small that it cannot be divided.
Attraction, (*ad, traho*, L.) *Lit.* a drawing to.
Cohesion, (*con, haereo*, L.) *Lit.* a sticking together.
Compressible, (*con, premo*, L.) capable of being compressed, or reduced by pressure into less bulk.
Contractibility, (*con, traho*, L.) capacity of being contracted, or reduced into less bulk, as by cold.
Density, (*densus*, L.) compactness, or closeness of constituent particles.
Dilatability, (*dilato, dis, latus*, L.) capacity of being enlarged.
Divisible, *indivisible*, *divisibility*, (*divide*, E., *divido*, L.)
Equilibrium, (*æquus, libra*, L.)
Extension, (*ex, tendo*, L.)
Friction, (*frico*, L.) *Lit.* rubbing; the resistance to a body moving on another, from the roughness of their surfaces.
Gravity, (*gravis*, L.) Hence also *gravitation*.
Impenetrability, (*in, penetro*, L.) *Lit.* incapability of being penetrated or pierced.
Inertia, (*iners*, L.) *Lit.* inactivity.
Mechanics, (*mechanè*, G.) the science of force and motion; *lit.* the science of contrivances or machines. Hence also *mechanical, machine, machinery, mechanic* (=artizan), *mechanism*.
Molecule, (*moles*, L.) the smallest particle of matter, an atom; *lit.* a little mass.
Pore, (*poros*, G.) a small opening. Hence *porous, porosity*.

PROPERTIES OF MATTER.

Our senses make us acquainted with an immense variety of substances, existing around us in different forms, and acting in many ways upon one another. There are the solid rocks, the liquid ocean, and the gaseous atmosphere; the hard diamond, and the soft clay; the odours of flowers, the dew-drops on the grass, the damp, raw mist which envelopes our Scottish hills, the eternal snow upon the Alps, and the burning lava of Etna and Vesuvius. All these, and the hundreds of other substances which our senses reveal to us, are included under the general name of *matter*. The stones are matter, the stream is matter, the cloud is matter, the atmosphere itself is matter. Every object, in short, which we can perceive by any of our senses, is composed of matter, or, in other words, is a *material* object. There is within us something that is not material, a living, thinking, yet unseen being, to which we give the name of soul or spirit. And we are taught in Scripture that there are other spirits, whom we perceive not, though they may be near us; nay more, that God himself, the Creator of all, is not a material, but a spiritual Being. The word matter, then, is opposed to spirit; the word material, to spiritual.

There are certain properties which distinguish matter in all its various forms; these are called its *general* properties. The first and most obvious is, that matter occupies space, or, to use the scientific term, that it possesses the property of *extension*. This seems scarcely to need explanation. It implies *length*, *breadth*, and *depth* or *height;* for depth and height are manifestly the same, only that depth is measured from the top of an object downwards, and height from the bottom upwards. Extension implies also *shape* or *figure*, which is determined by the three dimensions already referred to.

Since matter always occupies a certain space, whether more or less, it is natural to infer, that two substances cannot occupy the same space at the same time. Experience

proves that this inference is correct. Let the hand, for example, be plunged into a glass of water, the water will be displaced, and will rise in the glass higher than it was before. If the glass be full before the hand is introduced, a portion of the water will run over. The water resigns its place to the solid body, and seeks a new position, but the two do not at the same time occupy the same space. Even so is it when a nail is driven into a piece of wood. Little *pores* or *interstices* exist between the woody particles, and the nail makes room for itself by squeezing these particles more closely together. The wood is accordingly displaced from the space which the nail now occupies. Air itself is able to prevent any other substance from occupying the same place with it. If a cup or glass be plunged into water with its mouth downwards, so as to be completely submerged, the air it contains, having no means of escape, will keep the water from filling it. This may be easily proved by sticking a little bit of paper on the bottom of the glass inside, which will be found quite dry when the glass has been withdrawn from the water. It is upon this principle that diving-bells are constructed. It is equally true, then, of all kinds of matter, solid, liquid, or gaseous, that the space which is occupied by one substance cannot at the same time be occupied by another. This property is generally, though not very correctly, called *impenetrability*.

It is to be particularly observed, that, when a nail is driven into wood, the woody particles surrounding it are crushed into less space than they filled before. So also, in the experiment just described, of plunging an inverted glass into water, it is found that the water, though it does not fill the glass, rises in it to a certain extent. The air in the glass is compressed into a smaller space than it originally occupied, and its bulk becomes less and less, as the glass is pressed deeper and deeper into the water. Here, then, we have examples of another property of matter, *compressibility*. Air possesses this property in a high degree, wood in a lower degree, and some other substances

in a lower degree still; but there is good reason to believe that everything material is more or less compressible.

The dimensions of a body are affected by heat as well as by pressure. Bars of metal alternately heated and cooled, will alternately expand and contract. The blacksmith takes advantage of this in fitting the iron rim to a wheel. He puts on the rim when expanded by heat, so that, gradually contracting as it cools, it holds the wood-work with a firm grasp. Liquids also expand under the influence of heat, and contract when exposed to cold, and the same phenomena are exhibited by gases in a much higher degree. Putting out of view, therefore, a few exceptional cases, it may be said generally, that matter, in all its forms, possesses the properties of *dilatability* and *contractibility*. Hence the substances around us are constantly swelling and contracting under the vicissitudes of heat and cold. They grow smaller in winter, and dilate in summer. They swell on a warm day, and contract on a cold one. Even our own bodies are not altogether exempt from these changes, but the effects of temperature on them involve a good deal more than mere contraction and expansion.

PROPERTIES OF MATTER—CONTINUED.

SEVERAL of the properties of matter mentioned in last lesson, seem to depend on one which has also been already referred to, viz., its *porosity*. It scarcely admits of doubt that all bodies are composed of incredibly minute particles or *molecules*, between which there are little spaces called *pores*, capable of enlargement and diminution. In other words, every kind of matter is more or less porous, and by increasing or diminishing its porosity it may be *dilated* or *compressed*. Closely connected with porosity is another property called *density*. It is important that this term should be well understood. One substance is more dense than another, if a given bulk of the former contains more

matter, or (which is practically the same thing) *weighs* more than the same bulk of the latter. Hence the density of a substance is increased by compression or contraction, and diminished by dilatation. In ordinary cases, density is measured by *weight;* what weight itself is, will appear in a subsequent lesson.

Another remarkable property of matter is its *divisibility.* A lump of marble may be ground into a fine powder, but each grain is still a mere block of marble, capable of further division, if instruments could be found fine enough to divide it. It is a curious question, whether there is, in matter itself, any necessary or absolute limit to this process. The general opinion is, that the molecules already spoken of are ultimate and indivisible. We are able, by artificial means, to reduce some kinds of matter, especially the metals, to particles of surprising minuteness; but we seem to be still very far from the point, if there really be such a point, beyond which no further subdivision is possible. It is needless to state in figures the immense number of parts into which a small quantity of gold, for example, may be divided. "A million" is easily said, but the idea of a million of objects, or of the millionth part of an ounce of gold is not so easily realized. When, therefore, we have learnt that it is possible to divide an ounce of gold, not into a million of parts only, but into hundreds of millions, we may well ponder with amazement the stupendous fact, but we shall utterly fail to form any adequate conception of its meaning. The mind is overwhelmed by the contemplation of so great a number. Yet each of the parts thus obtained is visible to the naked eye, and retains all the essential qualities of the largest masses of the same metal.

Foremost in importance among the properties of matter, at least in the study of mechanics, is that known as *inertia.* Every material body must be either at rest or in motion. Now inertia consists in this, that, if a body be at rest, it cannot put itself in motion, and if it be in motion, it cannot change that motion nor reduce itself to rest. The first of these two statements, namely, that a body at rest cannot

of itself begin to move, will be at once understood and agreed to. But the truth of the second is not so obvious. It does seem, at first sight, that matter is more inclined to rest than to motion; for, if we roll a stone along the surface of the ground, it gradually moves more and more slowly, till at last it stops altogether. It would be a great mistake, however, to suppose that the stone stops in virtue of any power of its own. If the ground is made level, and the stone round and smooth, it will roll longer and farther, and on a sheet of ice longer and farther still. It appears, then, that the *friction,* as it is called, arising from the roughness of the stone itself, and of the surface on which it moves, tends to stop its motion. Besides, even if there were no friction, the stone has to move through the air, making way for itself as it goes by the displacement of that fluid; this also retards its progress, and would at length bring it to a state of rest. Friction, then, and the resistance of the air, are among the influences which oppose the continuance of motion in all bodies near the earth's surface, and the effect of their operation is so constant and so gradual, that we are apt to think moving bodies stop of their own accord. But it is only living bodies which have any such power. Nay more, it is not easy nor safe for even a living body, when in rapid motion, to stop suddenly. When a man leaps from a railway carriage in motion, his body retains, in virtue of its inertia, all the progressive motion which it had in common with the carriage. But no sooner do his feet touch the ground, than their motion is suddenly arrested, and the rest of his body, having still a tendency to go on, falls in the direction of the train's motion, and with a violence proportional to its speed. The same effect will be felt, though in a less degree, in leaping from an ordinary gig or cart.

We cannot, it is true, prove by actual experiment that a moving body has no inherent tendency to stop, because we cannot get rid of disturbing influences. But we have the strongest reasons for believing that, if these were removed, a motion once begun would continue for ever in the same

direction, and at the same rate. In the heavens we have a vast mechanism whose movements cannot be explained on any other supposition. The planets, and other celestial bodies, removed from all the casual obstructions and resistances which are unavoidable on the surface of the earth, roll on in their appointed paths with unerring regularity, preserving undiminished all that motion which they received at their creation from the Hand that launched them into space.

NATURE AND EFFECTS OF FORCE.

A BODY at rest, if not disturbed, will remain at rest for ever; a body in motion, if not disturbed, will move on for ever at the same rate, and in the same straight line. It has been explained that this passive indifference to rest or motion is what we mean by inertia. But, in the bodies around us, we see no such unbroken rest, and no such uniform motion. Many of them are observed beginning to move from a state of apparent rest, and the motion of others is ever changing both in direction and rapidity. A stone projected from the hand along a level surface is gradually stopped, as we have seen, by friction and the resistance of the air which it must displace. If it be thrown upwards, it very soon ceases to rise, and then falls again. But why does it fall? Or, why does it not fall upwards, instead of downwards? If, owing to its inertia, it has no power to change its motion, how is that motion changed into an opposite motion? The planets, as was stated in last lesson, roll on unceasingly, yet even they do not move always in the same direction. Their speed remains on the whole undiminished, yet it too is ever changing. How, we may well ask, are such facts to be explained?

As a first step towards the answer to these questions, and to many other questions such as these, it is obvious, that there must be, in all such cases, some power or influence

at work, by whose operation the inertia of the moving bodies is counteracted. As the rolling stone is retarded by friction, so the ascending stone must be stopped and pulled down again by some power acting upon it. It could not fall of its own accord. So also, the planets must be drawn, by some other influence, out of the straight line in which inertia would make them move. Now, every such influence, everything which counteracts the inertia of matter, which sets a body in motion, or has a tendency to set a body in motion, which stops a moving body, or alters its motion, or tends to alter it, either in direction or velocity—every cause which produces any of these effects, is called a FORCE. Force, then, is intimately connected with motion, for, whenever a force acts, motion is the natural result. It does not follow, however, that every force really does produce motion, because some other force or forces may counterbalance it. Forces which thus counterbalance, and, as it were, destroy each other, are said to be in *equilibrium*. But, it is to be particularly observed, that every force *would* produce motion, if nothing else interfered. When forces are not in equilibrium, motion must necessarily ensue.

The different kinds of force, the laws which regulate their action, and the effects which they produce, form the subject of a group of sciences, which are all included under the general name of *Natural Philosophy*.* It is to these sciences that we must look for an explanation of the various motions which we see around us. They tell us why a stone falls while a balloon rises; why the planets move in orbits nearly circular; why the thunder rolls; why the tide ebbs and flows; and (to come to the works of man) how the steam-engine is able, like a living creature, to pull its enormous load, or the electric telegraph to convey the thoughts and commands of men, with lightning speed, to the remotest corners of the earth.

* Or Mechanical Philosophy.

THE VARIOUS KINDS OF FORCE.

Forces are of different kinds. That which seems to require least explanation, and from which, probably, our first ideas of force are derived, is the *muscular power* of living animals. A man can produce a certain mechanical effect, varying according to his strength; a horse produces a greater effect, and an elephant a greater still. This will be at once and easily understood.

One kind of force has been already mentioned, which has rather a passive influence in retarding and destroying motion, than any active power to produce it. This is *friction*. It ceases to act where there is equilibrium, but is of very great importance in all mechanical problems in which motion is involved. Without it a railway train could not move forward at all; the engine wheels, in their revolution, would slip on the rails. Without it even walking would be impossible. Indeed, we find it difficult and unsafe to walk wherever there is much less than the usual amount of friction, as, for example, on a sheet of ice.

Heat, *magnetism*, and *electricity* also produce motion, and so far fall within the domain of mechanical science. But by far the most important of all the forces with which that science has to deal, is one which, manifesting itself in various forms, receives in all the general name of *attraction*. There is a mutual attraction between particles in close contact, which causes them to cohere into a lump or mass of greater or less consistency. This is sometimes called *cohesion*, or the *attraction of cohesion*. It is obviously a force of the greatest consequence, for, if it ceased to operate, every material object would crumble to atoms. But it does not produce perceptible motion, for it acts only when the particles are, or appear to be in contact. On the other hand, the *attraction of gravitation*, a force which binds together bodies far distant from each other, is the cause of all the most stupendous motions with which we are acquainted. It guides the moon in her course round the earth, and the earth itself in its annual circuit round the sun. Its influence extends to

all the other worlds that compose the universe, and gives to each its proper place and motion. And yet, how strange to think that it is the very same force which makes a stone fall to the ground!

The effects of this great universal principle must be more minutely examined. Every particle of matter in the universe attracts every other with a certain force. In short, every particle of matter, though utterly destitute of any power to set itself in motion, is endowed with a power, the tendency of which is to set in motion every other particle. The farther removed two particles are from each other, the less is this attraction between them. And here is a point which it is absolutely necessary to understand. If at a distance of one foot two particles attract each other with a certain force, then, at a distance of two feet, their attraction will be, not one-half, but only one-fourth of what it was before. At three feet, it will be only one-ninth, at four feet, one-sixteenth, and so on. This relation between the distance of two bodies and the force of their attraction, is expressed as follows:—"*Attraction varies inversely as the square of the distance between the attracting bodies.*" Such is one great law of attraction, and there is another no less important. Since every particle of matter in a body exerts an attraction independently of the rest, it follows that the total attraction which any body exerts, being made up of the separate attractions of its particles, *must be proportional to its mass*, that is, to the quantity of matter which it contains. The earth, for example, attracts the moon with a certain force, which would be twice as great if the quantity of matter in the earth were doubled. But farther, the earth attracts every particle of the moon independently of the rest, so that the total force which it exerts upon the moon must be proportional to the moon's mass, as well as to its own. The moon, in its turn, attracts the earth with a force also proportional to their respective masses, and, therefore, exactly equal to the earth's attraction upon it. Hence we have the second law of attraction—"*The mutual attraction of two bodies is proportional to their masses.*"

We are now in a position to understand why a stone, thrown into the air, soon falls again. Obviously, because the great mass of the earth exerts a strong attraction upon it. It is no doubt true that this attraction is mutual, that the stone, in its turn, attracts the earth with an equal force, and accordingly we might expect to see the earth rising to meet it as it falls. But it must be remembered that the space through which the earth moves, in obedience to this attraction, is small in proportion as the earth itself is large. Hence it is imperceptible.

The attraction of the earth, generally spoken of as *gravity*, acts powerfully on all terrestrial objects. By it our houses, our goods, our cattle, and even our own bodies, are made to rest firmly on the ground, instead of flying off into empty space. But for it, bodies would have no weight, for their weight is simply the force with which the earth attracts them. Thus, as if by an invisible chain, held by an invisible, but Almighty hand, we are bound to the world given us for a habitation; and not only so, but the whole frame of nature is linked together by the same all-pervading influence, by which also the motions of all its parts are directed and controlled.

QUESTIONS FOR EXAMINATION.

What is matter? What is its opposite? Name some of the general properties of matter. What is meant by impenetrability? Give an example of impenetrability in liquids, in gases, in solids. Explain compressibility, dilatability, contractibility. Give examples of each. On what other property do these last mentioned properties depend? Explain the term density. Is matter supposed to be infinitely divisible? Is there any practical limit to its divisibility, and if so, what is it? In what class of substances has artificial division been carried farthest? Give an example. What is meant by inertia? Why does a rolling stone stop? Give an example of inertia as it effects living bodies. What counteracts inertia? What are the several effects which a force may produce? When does it *not* produce motion? What is the subject of Natural Philosophy? Give examples of different kinds of force. Of what use is friction? What is cohesion? Of what use is it? What is the attraction of gravitation? How is it affected by distance? by mass? Mention some of its effects at the earth's surface, and in the heavens.

HUMAN LIFE.

[SAMUEL ROGERS, a distinguished poet, was born near London in 1762, and died in 1855. He was trained as a banker, which profession he continued to pursue through life. His writings are remarkable for elegance of diction, purity of taste, and beauty of sentiment. His larger works are, "The Pleasures of Memory," "Human Life," "Columbus," and "Italy."]

The lark has sung his carol in the sky;
The bees have hummed their noontide lullaby;
Still in the vale the village-bells ring round,
Still in Llewellyn-hall the jests resound;
For now the caudle-cup is circling there,
Now, glad at heart, the gossips breathe their prayer,
And crowding stop the cradle to admire
The babe, the sleeping image of his sire.

A few short years—and then these sounds shall hail
The day again, and gladness fill the vale;
So soon the child a youth, the youth a man,
Eager to run the race his fathers ran.
Then the huge ox shall yield the broad sirloin;
The ale, now brewed, in floods of amber shine;
And basking in the chimney's ample blaze,
'Mid many a tale told of his boyish days,
The nurse shall cry, of all her ills beguiled,
"'Twas on these knees he sat so oft and smiled."

And soon again shall music swell the breeze;
Soon, issuing forth, shall glitter through the trees
Vestures of nuptial white; and hymns be sung,
And violets scattered round; and old and young,
In every cottage-porch, with garlands green,
Stand still to gaze, and, gazing, bless the scene;
While, her dark eyes declining, by his side
Moves in her virgin veil the gentle bride.

And once, alas! nor in a distant hour,
Another voice shall come from yonder tower;
When in dim chambers long black weeds are seen,
And weepings heard where only joy has been;

When by his children borne, and from his door
Slowly departing to return no more,
He rests in holy earth with them that went before.

And such is human life;—so gliding on,
It glimmers like a meteor, and is gone!

ROGERS.

THE VOICE OF THE SHELL.

I have seen
A curious child, who dwelt upon a tract
Of inland ground, applying to his ear
The convolutions of a smooth-lipped shell;
To which, in silence hushed, his very soul
Listened intensely; and his countenance soon
Brightened with joy; for murmurings from within
Were heard—sonorous cadences! whereby,
To his belief, the monitor expressed
Mysterious union with its native sea.
Even such a shell the universe itself
Is to the ear of Faith; and there are times,
I doubt not, when to you it doth impart
Authentic tidings of invisible things;
Of ebb and flow, and ever-during power;
And central peace, subsisting at the heart
Of endless agitation.

WORDSWORTH.

THE VISION OF MIRZA.

ON the fifth day of the mòon, which I always keep hóly, after having wàshed myself' and offered up my morning devótions, I ascended the high hills of Bágdad, in order to pass the rést of the day' in meditátion and pràyer. As I was airing myself on the tops of the moúntains, I fell into a profound contemplátion' on the vanity of human lìfe; and passing from one thought to anóther, "Sùrely," said I, "màn is but a shádow, and lífe' a drèam." Whilst I was

thus músing, the Genius who haunts the moúntain| càme to me, and, taking me by the hánd, said, with a look of compassion and affabìlity, "Mìrza, I have heárd thee in thy solìloquies; fòllow me."

He then léd me to the highest pìnnacle, and placing me on the tóp of it, "Cast thy eyes èastward," said he, "and téll me what thou sèest." "I sèe," said I, "a huge válley| and a prodigious tide of wáter rolling throùgh it." "The válley that thou seest," said he, "is the Vale of Mìsery, and the tide of wáter that thou seest| is párt of the great Tide of Etèrnity." "What is the rèason," said I, "that the tíde that I see| rises out of a thick mìst at óne end, and again lóses itself| in a thick mist at the òther?" "What thou séest," said he, "is that portion of Etérnity| which is called tìme, measured out by the sún, and reaching from the beginning of the wórld| to its consummàtion. Examine now this séa, and téll me| what thou discòverest in it." "I see a brìdge," said I, "stánding in the mìdst of the tide." "The brídge thou seest," said he, "is human Lìfe; consíder it attèntively." Upon a more léisurely survey of it, I found that it consisted of threescore and ten entíre arches, with several bròken arches, which, added to those that were entíre, made up the number about a hùndred. As I was counting the árches, the Genius tóld me| that this brídge consisted at first of a thoùsand arches, but that a great flood swept away the rést, and left the bridge in the ruinous condítion I now behèld it. "But tell me fùrther," said he, "what discòverest thou on it." "I see multitudes of péople passing òver it," said I, "and a black cloúd| hanging on each ènd of it." As I looked móre attentively, I saw several of the passengers dropping throúgh the bridge| into the great tide that flowed undernèath it; and upon fúrther examination, perceived there were innumerable tráp-doors that lay concèaled in the bridge, which the passengers no sooner tród upon| than they fell through them into the tíde, and immediately disappèared. These hidden pítfalls| were set very thíck at the èntrance of the bridge, so that throngs of pèople| no sooner broke through the cloúd| than many fèll

into them. They grew thínner towards the mìddle, but multiplied and lay clóser together| towards the end of the árches that were entìre. There were indeed sóme persons, but their number was very smàll, that continued a kind of hobbling márch| on the broken àrches, but fell throùgh| one after anóther, being quite tired and spént| with so long a wàlk.

I passed some tìme| in the contemplation of this wonderful strúcture, and the variety of óbjects which it presènted; and as I lóoked, my heart was filled with a deep mèlancholy. "Alàs," said I, "mán| was made in vàin! How is he given away to mísery and mortàlity!" The Gènius, being moved with compássion towards me, bid me quit so uncòmfortable a prospect. "Look no mòre," said he, "on mán in the fìrst stage of his existence, in his setting óut for etèrnity; but cast thine eye on that thick míst| into which the tide bears the several generations of mórtals that fàll into it." I directed my síght| as I was òrdered, and (whether or no the good Génius| strengthened it with any supernàtural force, or dissipated part of the míst| that was before too thick for the eye to pénetrate) I saw the valley opening at the fúrther end, and spreading forth into an immense ócean, that had a huge rock of àdamant| running through the mídst of it, and dividing it into two equal pàrts. The cloúds still rested on òne half of it, ínsomúch| that I could discover nòthing in it; but the óther appeared to me a vast òcean| planted with innumerable íslands, that were covered with fruits and flówers, and interwoven with a thousand little shining séas| that rán amòng them. I could see pérsons| dressed in glorious hàbits, with garlands upon their héads, passing among the trèes, lying down by the sides of fóuntains, or resting on beds of flòwers; and could hear a confused harmony of singing bìrds, falling wáters, human vóices, and musical ìnstruments. Gladness grέw in me| upon the discóvery of so delightful a scène. I wished for the wings of an éagle| that I might fly awáy| to those happy sèats. But the Genius tóld me| that there was no pàssage to them, except through the gates of déath| that I saw opening every móment upon the brìdge.

"The ìslands," said he, "that lie so fresh and green befóre thee, are the mansions of good mén after dèath, who, according to the degrée and kìnds of virtue in which they excélled, are distríbuted among these several ìslands, which abound with pléasures| suitable to the relishes and perfections of thóse| who are sèttled in them; every ísland is a pàradise| accómmodated to its respective inhàbitants. Are not thèse, O Mirza, habitations worth conténding for? Does Lífe appear mìserable, that gives thee opportunities of earning such a rewárd? Is Déath to be fèared, that will convey thee to so happy an exístence? Thìnk not| man was made in váin, who has such an etérnity resèrved for him."

I gazed with inexpressible pléasure| on these happy ìslands. At léngth, said I: "Show me now, I beséech thee, the sècrets that lie hid under those dark cloúds which cover the ócean| on the òther side of the rock of adamant." The Gènius making me no ánswer, I turned abóut| to address myself to him| a sècond time, but I foúnd| that he had lèft me. I then turned again to the vísion| which I had been so lòng contemplating; but instead of the rolling tìde, the arched brìdge, and the happy íslands, I saw nóthing but the long hollow valley of Bàgdad, with òxen, shèep, and cámels| grázing upon the sìdes of it.

ADDISON.

THE VOICE AND PEN.

Oh! the orator's Voice is a mighty power
  As it echoes from shore to shore—
And the fearless Pen has more sway o'er men,
  Than the murderous cannon's roar.
What burst the chain far o'er the main,
  And brightens the captive's den?
'Tis the fearless Voice and the Pen of Power—
  Hurrah! for the Voice and Pen!
          Hurrah!
  Hurrah! for the Voice and Pen!

The tyrant knaves who deny our rights,
  And the cowards who blanch with fear,
Exclaim with glee, "No arms have ye—
  Nor cannon, nor sword, nor spear!
Your hills are ours; with our forts and towers
  We are masters of mount and glen."
Tyrants, beware! for the arms we bear
  Are the Voice and the fearless Pen!

Though your horsemen stand with their bridles in hand,
  And your sentinels walk around—
Though your matches flare in the mid-night air,
  And your brazen trumpets sound;
Oh! the orator's tongue shall be heard among
  These listening warrior men;
And they'll quickly say, "Why should we slay
  Our friends of the Voice and Pen?"

When the Lord created the earth and sea,
  The stars and the glorious sun,
The Godhead *spoke*, and the universe woke—
  And the mighty work was done!
Let a word be flung from the orator's tongue,
  Or a drop from the fearless Pen,
And the chains accursed asunder burst,
  That fettered the minds of men!

Oh! these are the swords with which we fight,
  The arms in which we trust;
Which no tyrant hand will dare to brand
  Which time cannot dim or rust!
When these we bore, we triumphed before—
  With these we'll triumph again;
And the world will say, "No power can stay
  The Voice and the fearless Pen!"
                Hurrah!
  Hurrah! for the Voice and Pen!

D. F. M'CARTHY.

EFFECTS OF MACHINERY.

Four hundred years ago, all the books in use were written with pen and ink, and the labour of making a book was very great indeed. Books were also very expensive, for the writers of them—*scribes,* as they were called—were scarce, as so few persons could write, and the large amount of time taken up in writing had to be well paid for. But when the art of printing was invented, it was found that a man with a printing press and types, could produce hundreds of times as many books with his *machinery,* as could the scribe with his *pen.* As the cost of a printer's labour was no more than the cost of the same amount of a scribe's labour, and the printer's labour was so much more productive, printed books could be sold much cheaper than those that were written. For if a scribe could write *one* book in a week, a printer could print at least *five hundred* of them, with the same amount of labour, and could, therefore sell each of them for very much less. Accordingly, when books began to be printed, so great was the difference between the costs of production by writing and by printing, that the scribes stood no chance of living, and very soon lost all their work. The *material* also was made more productive by the use of machinery for printing. The same quantity of paper that made only *one* written book, was enough to make many printed books, so that there was a saving of materials as well as a saving of labour. The cost of producing books having been so much reduced by the use of printing machinery, owing to their taking so much less material and labour to make them, their price was gradually reduced; and now a better Bible can be bought for a *shilling,* than could at one time be bought for *fifty pounds.*

In the manufacture of cotton goods also, the use of machinery has produced wonderful differences in price, because it has so much lessened the cost of production. Seventy years ago, cotton-spinners, with their machines, spun fine cotton threads that could not have been spun at all by hand, and which then sold at *twenty guineas* a pound. Since that time, the use of better machines has so much

decreased the cost of producing these fine threads—or yarns, as they are called—that the same quality of yarn can now be sold at *fifteen shillings* a pound.

Before the stocking loom was invented, a good pair of stockings cost five shillings, because of the amount of labour required to make them; by the same amount of labour with the stocking loom, a woman can make so many pairs, that each pair can be sold for a shilling. Within the last few years, farmers have begun to use reaping and thrashing machines, because they find that, after adding together the cost of the machines, and the cost of the labour required to work them, it costs much less to reap and thrash the wheat by these machines than to do it by the hand.

A sewing machine has lately been invented, by which a woman can do twenty times as much work as with her needle; it has made the labour of sewing twenty times as productive as before. This being the case, the cost of the labour of sewing with it, is only one-twentieth of the cost of the labour of sewing with the needle; and even after adding the greater cost of the machine, the cost of producing goods by the sewing machine is so much less than the cost of the same goods sewn with the needle, that they can be sewn at a much lower price. When more tailors, shirt, shoe, and dress makers, make use of these machines, we shall get clothes cheaper than we now do.

Now it is quite plain that all consumers benefit by the use of machinery, as they get commodities at a lower price in consequence. The only persons who are thought to *lose* by the use of machinery, are the work people, some of whom are sometimes thrown out of work by the use of a new machine, which requires fewer persons to attend it. But even these lose for a *time* only, because the increased demand for the cheapened articles, always in the end, gives employment to a larger number of people than were employed before the machine was used. This has clearly been the case with the use of machinery for printing. When this was first used, all the scribes lost their employment, but before long there was more than enough employment for them at

the printing presses, because of the greatly increased demand for books. Within a very few years, there were twenty times as many printers employed, as there once were scribes; and there can be no doubt but that there are now hundreds of times as many persons employed in producing books, as there would be if books were written. Ninety years ago, a cotton spinning machine was invented that enabled one man to do the work of twenty, and so threatened to turn out of work nineteen out of every twenty hand spinners. This caused them to be alarmed, to cry out against the use of these machines, and even to go about the country breaking them up, as they were thought to be the greatest enemies to the spinners. And so for a time they were, but it was not long before the decrease in price, that followed the use of this machine, so greatly increased the demand for cotton yarns, that there were many more persons wanted to attend to the new machines, than were before wanted to work the spinning wheels. So much has the demand continued to increase, that for every cotton spinner at work ninety years ago, there are now a *hundred;* yet people said that the use of machinery would ruin the work people. Twenty years ago, when passenger railways were coming into use, there was just as great an outcry against *them,* it was said that they would ruin all the people who owned coaches and coach horses, as they would all be useless. But that was soon found to be a mistake, and now it is well known that there are many more horses and coaches of different kinds employed in taking people to railway stations, than were employed before the railways were made, to say nothing of the numbers of *people* employed on railways. Altogether it may safely be said, that for every person employed in carrying people and goods, just before railways were made, there are now *fifty* employed.

Thus we have seen that the use of machinery, by reducing the cost of producing commodities, benefits *all.* It benefits the *consumers,* by enabling them to buy at lower prices; and it benefits the *producers,* by giving them more employment. As the producers are *consumers* also, it benefits *them* in two ways.

THE SONG OF STEAM.

Harness me down with your iron bands,
  Be sure of your curb and rein,
For I scorn the power of your puny hands,
  As the tempest scorns a chain.
How I laughed, as I lay concealed from sight
  For many a countless hour,
At the childish boast of human might,
  And the pride of human power!

When I saw an army upon the land,
  A navy upon the seas,
Creeping along, a snail-like band,
  Or waiting the wayward breeze;
When I marked the peasant faintly reel
  With the toil which he daily bore,
As he feebly turned at the tardy wheel,
  Or tugged at the weary oar;

When I measured the panting courser's speed,
  The flight of the carrier dove,
As they bore the law a king decreed,
  Or the lines of impatient love;
I could not but think how the world would feel,
  As these were outstripped afar,
When I should be bound to the rushing keel,
  Or chained to the flying car.

Ha! ha! ha! they found me at last;
  They invited me forth at length,
And I rushed to my throne with thunder blast,
  And laughed in my iron strength.
Oh, then ye saw a wonderous change
  On the earth and ocean wide,
Where now my fiery armies range,
  Nor wait for wind or tide.

Hurrah! hurrah! the waters o'er
  The mountains steep decline;
Time—space—have yielded to my power—
  The world! the world is mine!

The rivers the sun hath earliest blest,
  Or those where his beams decline,
The giant streams of the queenly west,
  Or the orient floods divine.

The ocean pales where'er I sweep,
  To hear my strength rejoice;
And the monsters of the briny deep
  Cower, trembling, at my voice.
I carry the wealth and the lord of earth,
  The thoughts of the god-like mind;
The wind lags after my flying forth,
  The lightning is left behind.

In the darksome depths of the fathomless mine
  My tireless arm doth play,
Where the rocks never saw the sun decline,
  Or the dawn of the glorious day.
I bring earth's glittering jewels up
  From the hidden cave below,
And I make the fountain's granite cup
  With a crystal gush o'erflow.

I blow the bellows, I forge the steel,
  In all the shops of trade;
I hammer the ore, and turn the wheel,
  Where my arms of strength are made;
I manage the furnace, the mill, the mint;
  I carry, I spin, I weave;
And all my doings I put into print
  On every Saturday eve.

I've no muscle to weary, no breast to decay,
  No bones to be "laid on the shelf,"
And soon I intend you "may go and play,"
  While I manage the world by myself.
But harness me down with your iron bands,
  Be sure of your curb and rein,
For I scorn the strength of your puny hands,
  As the tempest scorns a chain.

Anon.

PROPHECIES CONCERNING CHRIST.

[Beilby Porteus, an eminent English prelate, was born at York in 1731, and died in 1808. He was educated at Christ's College, Cambridge. In 1787 he was appointed to the bishopric of London, over which diocese he continued to preside till his death. Bishop Porteus was a man of deep erudition and considerable ability.]

The word Messiah signifies anointed, that is, a person appointed to some high station, dignity, or office; because, originally, among the eastern nations, men so appointed, particularly kings, priests, and prophets, were anointed with oil. Hence, the word Messiah means the person preordained and appointed by God to be the great Deliverer of the Jewish nation, and the Redeemer of all mankind. The word Christ means the same thing.

Now it was foretold concerning the Messiah, that he should come before the sceptre departed from Judah, that is, before the Jewish government was destroyed (Gen. xlix. 10); and, accordingly, Christ appeared a short time before the period when the Jewish government was totally overthrown by the Romans.

It was foretold that he should come before the destruction of the second temple: "The Desire of all nations shall come, and I will fill this house with glory, saith the Lord of hosts; the glory of this latter house shall be greater than of the former" (Haggai ii. 7, 9). Accordingly, Christ appeared some time before the destruction of the city and temple of Jerusalem by the Romans.

It was foretold, by the prophet Daniel, that he should come at the end of 490 years after the rebuilding of Jerusalem, which had been laid waste during the captivity of the Jews in Babylon, and that he should be cut off; and that, afterwards, the city and sanctuary of Jerusalem should be destroyed and made desolate (Dan. ix. 26). And, accordingly, at what time soever the beginning of the 490 years can, according to any fair interpretation of the words, be fixed, the end of them will fall about the time of Christ's appearing: and it is well known how entirely the city and

sanctuary were destroyed by the Romans some years after he was cut off and crucified.

It was foretold that he should perform many great and beneficial miracles—that the eyes of the blind should be opened, and the ears of the deaf unstopped—that the lame man should leap as a hart, and the tongue of the dumb sing (Isa. xxxv. 5); and this we know was literally fulfilled in the miracles of Christ: the blind received their sight, the lame walked, the deaf heard.

It was foretold that he should die a violent death—that he would be wounded for our transgressions, and bruised for our iniquities—that the chastisement of our peace should be upon him, and that with his stripes we should be healed —that God would lay on him the iniquity of us all (Isa. liii.; Dan. ix. 26); all which was exactly accomplished in the sufferings of Christ, "who died for our sins, the just for the unjust, that he might bring us to God" (1 Peter iii. 18).

It was foretold that to him should the gathering of the people be, and that God would give him the heathen for his inheritance, and the utmost parts of the earth for his possession (Ps. ii. 8); which was punctually fulfilled by the wonderful success of the gospel, and its universal propagation throughout the world.

Lastly, many minuter circumstances were told of the great Deliverer, or Redeemer, that was to come—that he should be born of a virgin—that he should be of the tribe of Judah, and the seed of David—that he should be born in the town of Bethlehem—that he should ride upon an ass, in humble triumph, into the city of Jerusalem—that he should be a man of sorrows and acquainted with grief—that he should be sold for thirty pieces of silver—that he should be scourged, buffeted, and spit upon—that he should be numbered with the transgressors (that is, should be crucified, as he was, between two thieves)—that he should have gall and vinegar given him to drink—that they who saw him crucified should mock at him, and at his trusting in God to deliver him—that the soldiers should cast lots for his garments—that he should make his grave with the

rich—and that he should rise again without seeing corruption.*

All these circumstances, it is well known, were foretold, and, to the greatest possible exactness, fulfilled in the person of Christ.

What now shall we say to these things? Here are upwards of twenty different particulars, many of them of a very extraordinary nature, which it was foretold, 700 years before our Saviour was born, would all meet in him, and which did all actually meet in his person. Is not this a most extraordinary consideration? There are but three possible suppositions that can be made concerning it: either that this was a mere fortuitous coincidence, arising entirely from chance and accident; or that these prophecies were written after the events had taken place; or, lastly, that they were real predictions, delivered many years before the events came to pass, and all fulfilled in Christ. That any one should by chance hit upon so many things, which should all prove true, and prove true concerning one and the same person, though several of them were of such a nature as were unlikely to happen *singly*, and by far the greatest part of which had never before happened singly to any person whatever—this, I say, exceeds all bounds of credibility, and all power of conjecture or calculation.

That these prophecies were not written or delivered after the things predicted had happened, is most certain; because they are found in books which existed long before these events came to pass—that is, in the books of the Old Testament; and the Jews themselves, the mortal enemies of Christ and his religion, acknowledge that these prophecies were in those books, exactly as we now see them, many hundred years before Christ came into the world.

The books themselves were in their own keeping, in the keeping of our adversaries, who would undoubtedly take effectual care that nothing favourable to Christ should be fraudulently inserted into them. The Jews were our

* Isa. vii. 14; Micah v.; Zech. xi. 12; Isa. liii. 12; l. 6; Ps. lxix. 22; xxiv. 7-18; Isa. liii. 9; Ps. xvi. 10.

librarians. The prophecies were in their custody, and are read in all their copies of the Old Testament, as well as in ours. They have made many attempts to explain them away, but none to question their authenticity.

It remains, then, that these are all real predictions, all centring in our Saviour, and in him only, and delivered many centuries before he was born. As no one but God has the foreknowledge of events, it is from him these prophecies must have proceeded; and they show, of course, that Christ was the person whom he had for a great length of time pre-determined to send into the world, to be the great Deliverer, Redeemer, and Saviour of mankind.

BISHOP PORTEOUS.

HYMN BEFORE SUNRISE IN THE VALLEY OF CHAMOUNI.*

[SAMUEL TAYLOR COLERIDGE, eminent as a poet, essayist, and philosopher, was born at Bristol in 1772, and died in 1834. He was educated at Jesus College, Cambridge, where he greatly distinguished himself as a classical scholar. His poems, both lyric and dramatic, are replete with beautiful imagery, profound thought, and sublime feeling. His prose works embrace many subjects interesting to mankind—theology, history, politics, literature, logic, and metaphysics.]

HAST thou a charm to stay the morning star
In his steep course? So long he seems to pause
On thy bald awful head, O sovran Blanc!
The Arvé and Arveiron at thy base
Rave ceaselessly; but thou, most awful Form!
Risest from forth the silent sea of pines,
How silently! Around thee and above
Deep is the air, and dark, substantial, black,
An ebon mass: methinks thou piercest it
As with a wedge! But when I look again,
It is thine own calm home, thy crystal shrine,
Thy habitation from eternity!
O dread and silent Mount! I gazed upon thee,
Till thou, still present to the bodily sense,

* The valley of Chamouni on the north-west of Mont Blanc, is the most celebrated in the Alps for its picturesque sites and the wild grandeur of its glaciers.

Didst vanish from my thought: entranced in prayer
I worshipped the Invisible alone.

Yet, like some sweet beguiling melody,
So sweet, we know not we are listening to it,
Thou, the meanwhile, wast blending with my thought,
Yea, with my life and life's own secret joy,
Till the dilating Soul, enrapt, transfused,
Into the mighty vision passing—there,
As in her natural form, swelled vast to Heaven!

Awake, my Soul! not only passive praise
Thou owest! not alone these swelling tears,
Mute thanks and secret ecstasy! Awake,
Voice of sweet song! Awake, my heart, awake!
Green vales and icy cliffs, all join my Hymn.

Thou first and chief, sole sovran of the vale!
O struggling with the darkness all the night,
And visited all night by troops of stars,
Or when they climb the sky, or when they sink:
Companion of the morning star at dawn,
Thyself earth's rosy star, and of the dawn
Co-herald! wake, O wake, and utter praise!
Who sank thy sunless pillars deep in earth?
Who filled thy countenance with rosy light?
Who made thee parent of perpetual streams?

And you, ye five wild torrents, fiercely glad!
Who called you forth from night and utter death,
From dark and icy caverns called you forth,
Down those precipitous, black, jagged rocks,
For ever shattered, and the same for ever?
Who gave you your invulnerable life,
Your strength, your speed, your fury, and your joy,
Unceasing thunder and eternal foam?
And who commanded (and the silence came),
"Here let the billows stiffen and have rest?"

Ye ice-falls! ye that from the mountain's brow
Adown ravines enormous slope amain—

Torrents, methinks, that heard a mighty Voice,
And stopped at once amid their maddest plunge!
Motionless torrents! silent cataracts!
Who made you glorious as the gates of Heaven
Beneath the keen full moon? Who bade the sun
Clothe you with rainbows? Who, with living flowers
Of loveliest blue, spread garlands at your feet?
God! Let the torrents, like a shout of nations,
Answer! and let the ice-plains echo, God!
God! sing ye meadow-streams with gladsome voice!
Ye pine-groves, with your soft and soul-like sounds!
And they too have a voice, yon piles of snow,
And in their perilous fall shall thunder, God!

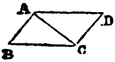
Ye living flowers that skirt the eternal frost!
Ye wild goats sporting round the eagle's nest!
Ye eagles, playmates of the mountain-storm!
Ye lightnings, the dread arrows of the clouds!
Ye signs and wonders of the elements!
Utter forth God, and fill the hills with praise!

Once more, hoar Mount! with thy sky-pointing peaks,
Oft from whose feet the avalanche, unheard,
Shoots downward, glittering through the pure serene,
Into the depth of clouds that veil thy breast—
Thou too again, stupendous Mountain! thou
That as I raise my head, a while bowed low
In adoration, upward from thy base
Slow travelling with dim eyes suffused with tears,
Solemnly seemest like a vapoury cloud
To rise before me. Rise, oh, ever rise!
Rise like a cloud of incense from the Earth!
Thou kingly Spirit throned among the hills,
Thou dread ambassador from Earth to Heaven,
Great hierarch! tell thou the silent sky,
And tell the stars, and tell yon rising sun,
Earth, with her thousand voices, praises God.

COLERIDGE.

REST AND MOTION.

Adjacent, (*ad, jaceo*, L.) lying near; the adjacent sides to AB in the figure ABCD, are AD and BC. DC is called the *opposite* side.



Centrifugal, (*centrum*, L., from *kentron*, G., and *fugio*, L.) flying from the centre.
Centripetal, (*centrum, peto*, L.) tending to the centre.
Curvilinear, (*curvus, linea*, L.) consisting of a curve line.
Diagonal, (*dia, gonia*, G.) a line joining opposite corners of a figure, as AC. (See under *adjacent*).
Orbit, (*orbis*, L.) a circular, or nearly circular path, as of a planet.
Parabola, (*para, ballo*, G.) the curve described by a projectile.
Project, (*pro, jacio*, L.) to throw forward. Hence also *projectile*.
Tangent, (*tango*, L.) a straight line touching a curve, but not cutting it.
Vertical, (*vertex*, L.) right up and down; perpendicular to the horizon. Hence also *vertically*.

THE LAWS OF MOTION.

Three brief maxims, known as the *laws of motion*, have embodied, since the days of Sir Isaac Newton, the fundamental principles by which all motion is regulated. They have been expressed in various forms, but have remained substantially unchanged.

I. The first is simply an assertion of the property of *inertia*. It declares that *every body must persevere in a state of rest, or of uniform motion in a straight line, unless compelled to change that state by some force impressed upon it.* This has already been sufficiently explained.*

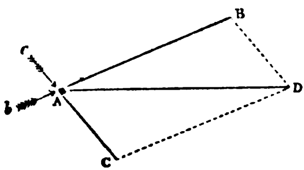
II. The second law may be stated thus:—*Every motion, or change of motion, must be proportional to the force impressed, and in the direction of that force.* It is important to notice the application of this law to the case of a body acted on by two or more forces simultaneously. If two forces act on a body in the same direction, it is clear that the velocity communicated to the body in that direction will be equal to the *sum* of the velocities which they would communicate to it by their separate action. If, on the other hand, they act in opposite directions, the result will be equal to the *difference* between the same velocities, and in the direction of the greater. Thus, if two men pull a boat in the same direction, the one imparting a velocity of six miles an hour, and the other a velocity of four miles an hour, the real velocity of the boat will be ten miles an hour.

* Page 225.

If, however, they pull against each other, the boat will move at the rate of two miles an hour in the direction in which the stronger man pulls.

Still more important is the case of forces acting on a body in different, but not opposite directions. Suppose two forces acting on the body A, impelling it in the directions A B and A C, as indicated by the arrows. If, in a given time, these forces, by their separate action, would carry the body A to B and C respectively, then, at the end of that time, the body will be found neither at B nor C, but at D, the opposite angle of the parallelogram A B C D, of which A B and A C are adjacent sides. If each of the forces be such as to produce a uniform velocity, the body will have moved with a uniform velocity along the diagonal A D.

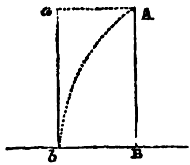
FIG. 22.



A few examples will render this more intelligible. If a swimmer direct his course right across a river, he will be carried down, ere he reach the opposite bank, exactly as far as a floating log would be in the same time. He will move, like the body A, along the diagonal of a parallelogram, of which one side is the breadth of the river, and the adjacent side is a line marking the distance he has been carried down. His real course will thus be much longer than the breadth of the river, but it will be completed in the same time as if it were the breadth of the river *only*. If he wishes to swim right across, he must make for a point further up the stream, and the singular result will be, that the space his body passes over will now be less, while the time and effort necessary to accomplish the passage will be much greater than in the former case. Suppose, again, a ball dropped from the top of a tall mast, while the ship is moving rapidly. It falls exactly at the bottom of the mast. It might be supposed, indeed, that the ship would have moved away, so to speak, before the ball could reach the

deck, and that the ball would therefore alight at some distance behind the mast. But it does not. Let A B represent the position of the mast when the ball is set free, and $a\,b$ the position it has arrived at when the ball strikes the deck. The ball, it is to be observed, has two motions; the one, a progressive motion in common with the ship, which alone would have carried it, in the time occupied by its descent, from A to a; the other, a motion produced by gravity, which alone would have carried it, in the same time, from A to B. Its real course is therefore from A to b; not, however, in a straight line, but in a curve, because the motion in falling is not uniform, as will be explained when we come to speak of gravity. From these examples, and many others of a like nature, it appears that *when more than one force acts on a body, each produces an effect, in its own direction, equal to what it would produce if it acted alone, and the real motion of the body is the aggregate of these effects.*

FIG. 23.



III. Every one knows that a moving body strikes with a greater or less force any obstacle that may lie in its way. But most people overlook the fact that the body which is struck always returns an equal blow. If a boy, by an incautious motion, knocks his head against his neighbour's, the two will suffer alike, unless one be struck on a more tender part than the other. When a boy flies a kite, the string pulls equally both ways, the kite and the boy's hand communicating to it exactly the same force. A bird, in flying, strikes the air with its wings, and the air, by its return blow, gives the body of the bird an upward and forward impulse. The fins of a fish, the arms of a swimmer, and the oars of a boat receive a similar impulse from the water. In all these instances, a certain force, acting in one direction, is accompanied by a corresponding force reacting in the opposite direction. Now the third law of motion asserts that this must always be the case. It is this: *Action and reaction must be equal and contrary; or, the forces exerted*

by two bodies upon one another must be equal, and their directions must be opposite.

Such are the three great principles which the immortal Newton, guided by the partially successful gropings of previous philosophers, was the first to announce with the prominence they deserve. Simple as they are, their establishment has led to some of the grandest discoveries recorded in the history of science.

MOTION PRODUCED OR MODIFIED BY GRAVITY.

The whole attraction exerted by the different parts of the earth's mass, may be considered as directed towards its centre; for, from the symmetry of its shape, the forces which draw a body towards opposite sides of the centre must obviously balance each other. A falling body, then, moves directly towards the centre of the earth. A ball, suspended by a string, has a tendency to move towards the same point, and accordingly will pull the string in that direction. A mason's plumb-line is a good example; it hangs in what we call a *vertical* line, a line which, if produced, would pass through the earth's centre. There all vertical lines would ultimately meet, so that they are not quite parallel; but any two of them, moderately near each other at the earth's surface, may for practical purposes be regarded as parallel lines.

It is quite in accordance with the testimony of our senses that falling bodies move in parallel or very nearly parallel directions, but we are not so ready to believe that all bodies, heavy and light, fall *with equal rapidity.* Nor do they in point of fact; yet they would do so if acted upon by gravity alone, and not retarded in their fall by the resistance of the air. There is a machine called an air-pump, by which nearly the whole of the air can be exhausted from a vessel of any size or shape. If a long glass tube be thus emptied of the air it contains, and then closed so as to be air-tight, it will be seen that a guinea and a feather, or any

similar bodies previously placed in it, will fall from one end to the other exactly in the same time. This has long been a rather celebrated experiment, but there is a simpler one which any boy may try for himself. He has only to get a penny, and cut a piece of paper into the same shape, but a little smaller. If he drop both from his hand at once, the penny will strike the ground long before the paper. But let him place the paper on the upper side of the penny, taking care that it lie flat, and that its edge do not overlap the penny at any point. If they be dropped in this position, so that the lighter body shall not have to overcome the resistance of the air, it will be found that both will reach the ground at the same time.

It is clear that the velocity of a falling body cannot be *uniform*. A stone dropped from the top of a high tower, is acted on by gravity during the whole time of its descent, and its speed is therefore constantly increasing.* Every successive instant it receives a new impulse, while still retaining the force it has already acquired. Thus, at the end of the first second after it has begun to fall, it is found to have attained a velocity of rather more than 32 feet per second. In course of the next second, it acquires as much more, so that at the end of two seconds its velocity is doubled. At the end of three, it will be tripled; and so on. *The velocity of a falling body is therefore proportional to the time since it began to fall.* The space, however, through which it falls, increases much more rapidly. It would be proportional to the time, if the velocity were uniform; but since the velocity itself increases in the same proportion as the time, the space must increase *in the same proportion as the square of the time.* This inference is verified by many ingenious experiments, which cannot here be described. It is found that a body, falling freely from a state of rest, and not resisted by the air, would describe a space of 16 feet 1 inch in one second; a space four times as large in two seconds; a space nine times as large in

* It is for this reason that gravity is called an *accelerating* force, and the motion it produces an *accelerated* motion.

three seconds; and so on. Hence the velocity of a falling body, and the force with which it strikes the ground, are not proportional, as is often supposed, to the height from which it has fallen, but only to the time which its fall has occupied.

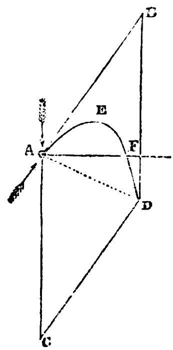
If, instead of being merely allowed to fall, a body is projected vertically downwards, with a certain force, that force, acting along with, and aiding the force of gravity, will bring the body sooner, and with greater velocity, to the ground. The velocity produced by the joint action of the two forces, is the sum of the velocities which they would produce if they acted separately. Let us suppose, on the other hand, that the body is projected vertically upwards. In that case, the force of projection will be opposed by gravity. The velocity of the body, at any instant during its ascent, will be the difference between the upward velocity with which it was projected, and the downward velocity which gravity would have imparted to it if it had from the first been free to fall. This downward velocity increases as the time increases, until at last it becomes exactly equal to the velocity of projection. The body then ceases to rise, and being now free, will fall again in obedience to the force of gravity alone. It will be seen, on a little consideration, that its ascent and descent must occupy exactly equal times, and that every point in its course will be passed twice, each time with the same velocity. All this is on the supposition that the body is not resisted by the air, which, however, in reality, will oppose its progress both in ascending and descending.

There is yet another case to be noticed, that of a body projected in a direction not vertical. Suppose a body A (fig. 24) to be projected in the direction A B with such a velocity as would carry it to the point B in five seconds, if gravity did not act upon it. But in five seconds the same body would fall, if acted upon by gravity alone, a little more than 400 feet. Let A C represent that distance. At the end of the five seconds, then, the body will be found, in accordance with a principle formerly explained,* at D, the opposite angle of the

* Page 246.

parallelogram of which A B and A C are adjacent sides. It does not, however, pass along the diagonal A D, for the effect of gravity is at first comparatively small, and draws it but little out of the straight line A B, in which it tends to move at the moment of projection. But since the effect of gravity increases as the square of the time, it gradually diverges from that line more and more rapidly, and so describes the curve A E F D, until some obstacle interrupts its progress. If the ground is level, as A F, the body will be stopped by it at the point F. A body moving in this way is called a *projectile*, and the curve it describes a *parabola*.

FIG. 24.



A stone thrown slantingly upwards, with moderate force, very well illustrates this kind of motion. A rifle-ball is also a projectile; but, from its great velocity, it meets with so strong a resistance from the air, that it deviates very much from the path it would otherwise pursue. There is, however, no difficulty in seeing why a rifle is not directed exactly to the point which the marksman intends to hit, but considerably above it, allowance being made for the effect of gravity upon the ball as it speeds on to its destination.

CENTRE OF GRAVITY.

THE force of gravity acting on a body causes it to fall; or, if it is supported so that it cannot fall, it will exert a certain pressure on the body that supports it. But we may observe that a body which is not free to fall right downwards, often tumbles to one side, and so assumes a new position. If, for example, we wish to lay down an egg on a level table, we can put it in a great many positions in which it will not remain at rest. A cart on a level road

stands securely, and even when one wheel is raised a little by passing over a stone, it rights itself again as soon as possible. But let the stone be a large one, or let the wheel rise on a high bank, and the cart will probably be upset. The bodies of living animals are aided by their muscular activity in maintaining any desired posture, yet there are many postures which we ourselves cannot assume without the risk, or even the certainty of a fall.

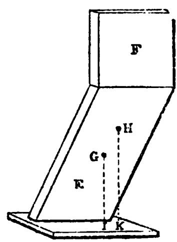
It thus becomes an interesting question, why a body can stand only in certain positions, and what are the conditions of its standing or falling. In order to answer this, we must consider once more the nature of the force of gravity, which produces these effects. It must be borne in mind that this force acts on every particle of a body independently of the rest. Every particle is urged, as if by a separate impulse, towards the centre of the earth. We have therefore to consider, not a single force, but a number of separate forces acting in parallel lines and in the same direction. Now there is in every body, a certain point round which all these forces balance each other. If this point be fixed, the forces on any one side of it will tend to pull that side downwards, which they can do only by raising the other side; the forces on the other side have an exactly opposite tendency; and, since they balance each other, no motion will ensue. In short, there is a certain point in every body, such that, if it be fixed, gravity cannot make the body move. The whole force of gravity, then, on the different parts of the body, may be considered as collected at that point, for it is only by moving that point that gravity can produce any motion at all. The point in question is therefore called the *centre of gravity.* Every body has a centre of gravity, though in some its position is not so easily ascertained as in others. In a regular symmetrical body, it is quite easy to see where it must be. For instance, in a straight rod of uniform thickness and density, it must be at an equal distance from both ends. In a sphere, or a spheroidal body like the earth, it is at the centre. Its position may be determined by mathematical reasonings, in all

bodies of regular figure; in others it has to be found by experiment.

It will now be easy to understand why a body remains at rest in some positions, and not in others. The whole force of gravity upon it, or, in other words, its whole weight, may be considered as one single force acting downwards from its centre of gravity, and urging that point to descend. If the centre of gravity is free to obey the impulse, it will descend accordingly; but if it be supported, the whole body will remain at rest.

Suppose a body E (fig. 25), whose centre of gravity is at G, to stand slantingly on a horizontal surface. The weight of the body acts in the vertical line G I, which is called the *line of direction*. Since this line falls within the base of the body E, the centre of gravity cannot move downwards, and the body will stand. But if a heavy body F be placed on the top of the body E, the common centre of gravity of the two bodies will evidently be at some point above G. Let it be at H. The line of direction is now H K, which falls beyond the base on which the bodies rest. The centre of gravity is no longer supported, and both bodies will tumble down.

FIG. 25.



It appears from this example, that a body stands the more securely, the lower the position of its centre of gravity. Every one knows how dangerous it is to load a cart, a coach, or (worst of all) a boat, in such a way as to make it top-heavy. The base on which a coach rests is the space inclosed by the wheels; so that, if the line of direction fall beyond the wheels, the coach will certainly be overturned. The higher the centre of gravity, the more likely is this disaster to occur. When a boat, in a stormy sea, is almost capsized by the heaving of the waves, the passengers, in their alarm, are apt to start up from their seats. Nothing can be more foolish; for, by their doing so, the centre of gravity is raised, and the danger consequently increased.

The centre of gravity of the human body is situated in the lower part of the trunk. When a man stands, his base is the space covered by the soles of his feet, including also the space, if any, which intervenes between them. A porter, carrying a load on his back, leans forward, so that the common centre of gravity of himself and his load may be directly above that base. If he tried to stand erect, the line of direction would pass behind his heels, and he would inevitably fall backwards. A nurse with a child in her arms leans back for a like reason. A sailor acquires the habit of walking with his feet far apart, thus giving himself a broader base, that he may tread more steadily on the moving deck.

It is unnecessary to multiply examples; the thoughtful reader will find them for himself at every turn. He should now be able to tell, without further explanation, why a man, with a pitcher in one hand, leans to the other side—why a person stooping forward advances one foot—why a very fat man carries his head and shoulders so far back—why a man standing on one foot inclines his body to the same side—why, in walking, we move ourselves alternately from one side to the other—why two persons, walking arm in arm, jostle each other when they do not keep the step—why a person in danger of falling stretches out his arm, and perhaps his leg, in the opposite direction—and finally, why a person cannot rise from his seat without either bending his body forward, or drawing his feet backward. When all this has been duly considered and understood, it can hardly fail to suggest the reflection, how little we are conscious of the profound and far-reaching principles, which often regulate the most trivial actions of our daily life.

CENTRIFUGAL AND CENTRIPETAL FORCE.

The earth attracts a stone, and the stone falls; the earth attracts the moon, but the moon does not fall. Why is this? Not because the moon is larger than the stone, for

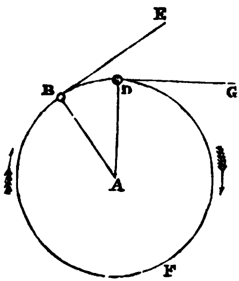
the larger it is, the greater the force with which it is attracted. Nor yet because the moon is farther away than the stone, for though the distance does greatly diminish the force of the earth's attraction, it cannot destroy it altogether. There can be no doubt that the moon would move towards the earth, slowly at first, perhaps, but not the less surely, if the attraction of the earth were not counteracted by some other force. Now what is that force?

The best way to arrive at the answer to this question, will be to consider, first, the motion of a stone whirled round the hand in a sling. Every boy knows how tightly it stretches the cords of the string, as if it wished to get away. It requires a constant muscular effort of the hand to keep it in a circular, or nearly circular course. There seems to be some force impelling it outwards, and whenever one of the cords is let go, it accordingly flies off with great velocity. Now, the point to be determined is this:—What is the force which gives it this outward impulse? The hand is the centre round which the stone revolves in something like a circle, and towards which the cords of the sling, or rather the hand acting through them, is constantly pulling it. But this force which the hand exerts, and which is called, for an obvious reason, a *centripetal* (or *centre-seeking*) force, does not succeed in actually bringing the stone to the centre round which it moves. Why does it not? What is that counteracting influence, which urges the stone away from the centre of revolution, and may therefore be called, as it has usually been, a *centrifugal* (or *centre-flying*) force?

It is surprising to find that this centrifugal force is nothing else than inertia. Suppose the hand to be at A (fig. 26), and the stone to be whirled round it in the direction shown by the arrows. When the stone has reached the point B, it is moving, for the instant, in the direction of the straight line BE, which touches the circle at that point, and is therefore called a *tangent*. If every external force now ceased to act upon it, its inertia would carry it, without any change of velocity, along the tangent towards E. And this is nearly what happens when one of the cords of the

sling is let go, and the stone thereby set free. But so long as it is confined in the sling, it is clear that it cannot proceed towards E, unless the hand were to move from A. It accordingly pursues a course as near the line BE, as the length of the sling will permit; that is to say, it stretches the cords in that direction, and describes the curve BD. Its circumstances are similar in many respects to those of a projectile. Impelled by its inertia towards E, and pulled by the cords of the sling towards A, it takes a middle course between these two directions, and, as in the case of projectiles, that course is curvilinear. When it arrives at D, its tendency to move along the tangent DG is counteracted and modified as before, by the cords continuing to pull it towards A.

FIG. 26.



It is this tendency to "fly off at a tangent," as it is often expressed, to which the name of centrifugal force has been given. It is to be observed that it is not a force acting *directly* away from the centre round which a body revolves. But it urges the revolving body in a direction which would carry it every moment farther and farther from that centre, so that the term "centrifugal" cannot be pronounced inaccurate.

In considering the motion of the stone in a sling, no account has been taken of its weight, that is, of the effect of gravity upon it. But it is worth while to notice, that the stone does not fall, even when it is at the top of its circuit, and has consequently no support beneath it. The reason is, that the centrifugal force is greater than the weight of the stone, and therefore keeps it in its place. The same thing may be shown still more strikingly by whirling a pail of water in the hand. It will be found that, if the pail be whirled rapidly enough, though the mouth of it be presented downwards at one part of each revolution, not a drop of the water will be spilt.

We see around us many examples of this kind of force. When a boy runs round a corner, there is a certain centrifugal force which impels him outwards, and he resists the impulse by inclining his body towards the corner. A horse galloping round the ring in a circus, leans, for a like reason, towards the centre of the ring. The rider does the same thing; if he tried to stand erect, he would soon be thrown off the horse, and probably out of the ring altogether.

We can now understand why the moon does not fall. Its motion round the earth resembles, in many respects, that of a stone in a sling. Its orbit is nearly circular. The earth's attraction is the cord which prevents it from flying off at a tangent to that orbit. Its centrifugal force, again, prevents it from falling to the earth in obedience to that attraction, and the two together have the effect of impelling it onwards in its curvilinear path. Nor is it the moon alone which moves in accordance with these principles. On the contrary, the earth and moon together perform a similar revolution round the sun, and are kept in their proper place by an exact adjustment and balancing of the same two forces; their own centrifugal force on the one hand, and, on the other, the attraction of the sun, which, like every other attraction, acts always as a centripetal force. The planets, too, observe the same laws in their unceasing movements, and so does every revolving body in the universe. It is a beautiful characteristic of the works of God, that the grandest and most complicated results, alike with the simplest and most insignificant, are often traceable to the multiform operation of one or two plain, intelligible, comprehensive principles.

QUESTIONS FOR EXAMINATION.

Who first prominently announced the laws of motion? State them. Explain the effect of two forces acting on a body in the same directions—in opposite directions—in different, but not opposite directions. Give examples in each case. What is meant by action and reaction? Give examples. What is a vertical line? Are vertical lines parallel? Describe experiments showing that all bodies should fall with equal rapidity. Why do they not in ordinary circumstances? What is an accelerating force? What is the relation, in the case of a falling body, between the time, the velocity, and the space? How far will a body fall in six seconds? Describe the motion of a body projected vertically

downwards—vertically upwards—in any direction not vertical. Give examples of projectiles. What is the centre of gravity? Where is the centre of gravity of a sphere? What is the condition that determines whether a body will stand or fall? Give examples from inanimate objects—from men's postures. What two forces besides gravity act upon a stone whirled in a sling? What is centrifugal force? In what direction does it act? Give examples of its overcoming gravity. Describe the motion of a stone in a sling, and compare it with the motions of the moon and other heavenly bodies.

THE LAKE OF GENEVA.

Clĕar, plácid Lèman! thy contrasted làke,
With the wild world I dwélt in, is a thing
Which wárns me, with its stìllness, to forsake
Earth's troubled wáters| for a púrer sprìng.
This quiet sáil| is as a noiseless wíng
To waft me from distràction; ónce| I loved
Torn òcean's roar, but thy soft múrmuring|
Sounds swéet| as if a sìster's voice reproved,
That I with stérn delights| should é'er have been so mòved.

It is the hush of nìght, and áll| between
Thy margin and thy moúntains dúsk, yet clèar,
Méllowed and mìngling, yet distinctly séen,
Save darkened Jùra, whose capt héights| appear
Precipitously stèep; and drawing néar,
There breathes a living fragrance from the shóre,
Of flówers yet fresh with chìldhood; on the éar|
Drops the light drip| of the suspended óar,
Or chirps the grásshopper| one góod-night carol mòre;

Hé| is an evening rèveller, who makes
His life an ínfancy, and sings his fìll;
At intervals, some bird from out the brákes|
Starts into voice a móment, then is stìll.
There seems a floating whisper on the hìll,
But thát| is fàncy, for the starlight déws
All sìlently| their tears of love instil,
Wèeping themselves awáy, till they infuse
Deep into nature's bréast| the spírit of her hùes.

Ye stárs! which are the pòetry of heaven!
I'f in your bright lèaves| we would read the fate
Of men and émpires—'tis to be forgìven,
That in our aspirations to be greát,
Our destinies o'erleap their mórtal state,
And claim a kindred with yoù; for yé| are
A beaúty and a mỳstery, and creàte
In us| such love and reverence from afár,
That fórtune, fàme, pòwer, lífe, have námed themselves a stàr.

All heaven and éarth are stìll—though not in sléep,
But bréathless, as wé grow| when feeling mòst;
And silent, as wé stand| in thoughts too dèep:—
All heaven and éarth are stìll: From the high host
Of stàrs, to the lulled lake and mountain cóast,
All is concèntered| in a life intènse,
Where not a bèam, nor áir, nor lèaf is lost,
But hath a párt of bèing, and a sense
Of thát| which is of áll| Creátor and defènce.

* * * * * *

The sky is chànged| and sùch a change! Oh níght,
And stòrm, and dárkness, ye are wòndrous strong,
Yet lóvely in your strength, as ìs the light
Of a dark eýe in wòman! Far alóng,
From peak to pèak, the rattling crágs among,
Léaps the live thùnder! not from one lone cloúd,
But every moùntain now hath found a tóngue,
And Jùra answers, through her misty shroúd,
Back to the joyous A'lps, who call to hér aloùd!

And thís| is in the nìght! Most glròious night:
Thoù wert not sent for slúmber! let mé| be
A shàrer in thy fiérce and fàr delight,—
A pòrtion of the témpest| and of thèe!
How the lit lake shìnes, a phosphoric sèa,
And the big ráin| comes dàncing to the earth!
And now agàin 'tis black—and now, the glee
Of the loud hílls| shakes with its mountain-mírth,
As if they did rejóice| o'er a young éarthquake's bìrth.—BYRON.

THE SIEGE OF TORQUILSTONE; FRONT-DE-BŒUF'S CASTLE.

WITH patient courage, Rebecca took post at the lattice, sheltering herself, however, so as not to be visible from beneath.

"What dost thou see, Rebecca?" again demanded the wounded knight.

"Nothing but the cloud of arrows flying so thick as to dazzle mine eyes, and to hide the bowmen who shoot them."

"That cannot endure," said Ivanhoe; "if they press not right on to carry the castle by pure force of arms, the archery may avail but little against stone walls and bulwarks. Look for the Knight of the Fetterlock, fair Rebecca, and see how he bears himself, for as the leader is, so will his followers be."

"I see him not," said Rebecca.

"Foul craven!" exclaimed Ivanhoe, "does he blench from the helm when the wind blows highest?"

"He blenches not! he blenches not," said Rebecca, "I see him now, he leads a body of men close under the outer barrier of the barbican. They pull down the piles and palisades; they hew down the barriers with axes. His high black plume floats abroad over the throng, like a raven over the field of the slain. They have made a breach in the barriers—they rush in—they are thrust back! Front-de-Bœuf heads the defenders; I see his gigantic form above the press. They throng again to the breach, and the pass is disputed, hand to hand, and man to man. It is the meeting of two fierce tides—the conflict of two oceans moved by adverse winds."

She turned her head from the lattice, as if unable longer to endure a sight so terrible.

"Look forth again, Rebecca," said Ivanhoe, mistaking the cause of her retiring; "the archery must in some degree have ceased, since they are now fighting hand to hand. Look again, there is now less danger."

Rebecca looked again, and almost immediately exclaimed,

"Holy prophets of the law! Front-de-Bœuf and the Black Knight fight hand to hand on the breach amid the roar of their followers, who watch the progress of the strife. Heaven strike with the cause of the oppressed and of the captive!" She then uttered a loud shriek, and exclaimed, "He is down! he is down!"

"Who is down," cried Ivanhoe; "for our dear Lady's sake, tell me which has fallen?"

"The Black Knight," answered Rebecca faintly, then instantly again shouted with joyful eagerness, "But no—but no! the name of the Lord of hosts be blessed! he is on foot again, and fights as if there were twenty men's strength in his single arm. His sword is broken—he snatches an axe from a yeoman—he presses Front-de-Bœuf with blow on blow. The giant stoops and totters like an oak under the steel of the woodman—he falls—he falls!"

"The assailants have won the barriers, have they not?" said Ivanhoe.

"They have—they have!" exclaimed Rebecca, "and they press the besieged hard upon the outer wall; some plant ladders, some swarm like bees, and endeavour to ascend upon the shoulders of each other—down go stones, beams, and trunks of trees upon their heads, and as fast as they bear the wounded to the rear, fresh men supply their places in the assault. Great God! hast thou given men thine own image, that it should be thus cruelly defaced by the hands of their brethren!"

"Think not of that," said Ivanhoe, "this is no time for such thoughts. Who yield? Who push their way?"

"The ladders are thrown down," replied Rebecca shuddering, "the soldiers lie grovelling under them like crushed reptiles. The besieged have the better."

"Do the false yeomen give way?" exclaimed the knight.

"No!" exclaimed Rebecca, "they bear themselves right yeomanly—the Black Knight approaches the postern with his huge axe—the thundering blows which he deals, you may hear them above all the din and shouts of the battle. Stones and beams are hailed down on the bold champion—

he regards them no more than if they were thistle-down or feathers!"

"By St. John of Acre," said Ivanhoe, raising himself joyfully on his couch, "methought there was but one man in England that might do such a deed!"

"The postern gate shakes," continued Rebecca, "it crashes—it is splintered by his blows—they rush in—the outwork is won—they hurl the defenders from the battlements—they throw them into the moat. O men, if ye be indeed men, spare them that can resist no longer!"

"The bridge, the bridge which communicates with the castle—have they won that pass?" exclaimed Ivanhoe.

"No," replied Rebecca, "the Templar has destroyed the plank on which they crossed—few of the defenders escaped with him into the castle—the shrieks and cries which you hear tell the fate of the others. Alas! I see it is still more difficult to look upon victory than upon battle."

SCOTT.

THE FIRST TWO STANZAS OF MARMION; A TALE OF FLODDEN FIELD.

DAY set on Norham's castled steep,
And Tweed's fair river, broad and deep,
 And Cheviot's mountains lone!
The battled towers, the Donjon Keep,
The loop-hole grates where captives weep,
The flanking walls that round it sweep,
 In yellow lustre shone.
The warriors on the turrets high,
Moving athwart the evening sky,
 Seemed forms of giant height:
Their armour, as it caught the rays,
Flashed back again the western blaze,
 In lines of dazzling light.

St. George's banner, broad and gay,
Now faded, as the fading ray
  Less bright, and less, was flung;
The evening gale had scarce the power
To wave it on the Donjon tower,
  So heavily it hung.
The scouts had parted on their search,
  The castle gates were barred;
Above the gloomy portal arch,
Timing his footsteps to a march,
  The warder kept his guard;
Low humming, as he paced along,
Some ancient Border gathering-song.

SCOTT.

THE DEATH OF MARMION.

WITH fruitless labour, Clara bound,
And strove to staunch the gushing wound:
The Monk, with unavailing cares,
Exhausted all the Church's prayers.
Ever, he said, that, close and near,
A lady's voice was in his ear,
And that the priest he could not hear,
  For that she ever sung,
"In the lost battle, borne down by the flying,
"Where mingles war's rattle with groans of the dying!"
  So the notes rung;—
"Avoid thee, Fiend! with cruel hand,
"Shake not the dying sinner's sand!
"O look, my son, upon yon sign
"Of the Redeemer's grace divine;
  "O think on faith and bliss!
"By many a death-bed I have been,
"And many a sinner's parting seen,
  "But never aught like this."

The war, that for a space did fail,
Now trebly thundering swelled the gale,
  And—Stanley! was the cry;
A light on Marmion's visage spread,
  And fired his glazing eye:
With dying hand, above his head
He shook the fragment of his blade,
  And shouted "Victory!
"Charge, Chester, charge! On, Stanley, on!"
Were the last words of Marmion. SCOTT.

SPEECH OF CICERO AGAINST CATILINE.

CATILINE! how fàr art thou to abuse our forbearance? How lòng are we to be deluded by the móckery of thy màdness? Whère art thou to stóp[1] in this caréer of unbridled licèntiousness? Has the nightly guard at the Palàtium[1] nothing in it to alárm you; the patroles throughout the cíty, nothing; the confusion of the péople, nothing; the assemblage of all true lovers of their coúntry, nothing; the guarded majesty of this assémbly, nothing; and all the eyes that, at this instant, are rivetted upon yoúrs—have thèy nothing to denoúnce, nor yoù to apprĕhend? Does not your conscience infórm you, that the sùn[1] shines upon your sécrets? and do you not discover a full knowledge of your conspiracy[1] revealed on the countenance of every man aroúnd you? Your employment on the last nìght—your occupations on the precèding night—the plàce where you met—the persòns who met—and the plot fabricated at the méeting:—of thèse things, I ask not who knóws; I ask, whò, among you áll, is ìgnorant?

But, alas! for the times thus corrúpted; or rather for mankínd, who thus corrùpt the times! The sénate[1] knòws all this! The cónsul[1] sèes all this! and yet the man who sits thére—lìves. Líves! áy—comes down to your sènate-house; takes his séat, as counsellor for the còmmonwealth; and, with a deliberate destiny in his eýe, marks out our

mémbers, and selects them for slàughter; while for ùs, and for our coúntry, it seems glory sufficient| to escape from his fúry—to find an asylum from his swòrd.

Lòng, vèry long, before this late hóur, ought I, the cón-sul, to have doomed this ringleader of sedítion| to an ignominious dèath—óught I to have overwhélmed you, Çatiline, in the rúins of your own machinàtions. Whát! did not that great man, the high-priest, Publius Scípio—although at the time in private stàtion—sacrifice Tiberius Grácchus| for dáring even to mòdify our constitution? and shall wé, clothed as we are with the plenitude of cónsular power, endure this nùisance of our nation and our náme? Shall we sùffer him| to put the Roman Empire to the swórd, and lay waste the wòrld, because such is his horrid fáncy? With the sanction of so late a précedent, need I obtrude the fate of the innovàtor, Spurius Mélius, immolated at the altar of the constitùtion, by the hand of Servilius Ahála? There hàs—yés, there hàs been, and làtely been, a vìndicatory virtue, an avènging spirit in this repúblic, that nèver failed| to inflict speedier and heavier vengeance on a noxious citízen, than on a national fòe. Against yoú, Catiline, and for your immediate condemnátion, whàt, therefore, is wanting? Not the grave sanction of the sénate—not the voice of the coúntry—not ancient précedents—not living làw. But *wè* are wanting—I say it more loùdly—WE, the consuls themsèlves.

Conscript Fàthers, a camp is pitched against the Roman repúblic, within Itàly, on the very borders of Etrùria. Every dáy| adds to the number of the ènemy. The lèader of those enemies, the commánder of that encampment, wálks within the walls of Ròme; takes his seat in this sénate, the heàrt of Rome; and, with venomous míschief, ràncles| in the inmost vítals of the còmmonwealth. Catilìne, shoúld I, on the ìnstant, order my lictors to seize and drag you to the stáke, sóme men might, even thèn, blame me for having procràstinated punishment; but nò man could críminate me| for a faithful execution of the làws. They shàll be executed. But I will neither áct, nor will I sùffer, without full and sufficient rèason. Trùst me, they

shàll be executed; and thén, even thèn, when there shall not be found a man so flagítious, so much a Càtiline, as to sáy| you were not ripe for execution. You shall líve| as long as there is òne who has the forehead to sáy| you òught to live; and you shall live, as you live nów, under our broad and wakeful eỳe, and the sword of jústice| shall keep waving round your hèad. Without the possibility of hèaring, or of séeing, yoù shall be séen, and heárd, and understòod.

Was not the night before the làst| sufficient to convínce you, that there is a good gènius| protecting that repúblic| which a ferocious demòniac| is labouring to destróy? I avèr that, on thát sáme nìght, you and your complótters| assembled in the house of Marcus Portius Lècca. Can even your own tòngue deny it? Yét secret! speak oùt, man; for, if yoú do not, there are sòme I see around me| who shall have an agonising próof| that I am trùe in my assertion.

Gòod and great góds! where àre we? What cíty do we inhàbit? Under what góvernment do we lìve? Hère, HERE, Conscript Fathers, mixed and mingled with us áll—in the centre of this most grave and venerable assémbly—are men sítting, quietly incubating a plot against mý life, against all yoùr lives; the life of every virtuous sénator and cìtizen: while I', with the whole nèst of traitors brooding beneath my eỳes, am parading in the petty formalities of debàte; and the very men appear scarcely vulnerable by my vóice, who ought, long since, to have been cut down with the swòrd.

In the house of *Lécca*, you were, on that nìght. Thèn and thére| did you divide Italy into military stàtions; did you appoint commànders of those stations; did you specify thòse| whom you were to take alóng with you, and thóse| whom you were to leave behìnd; did you mark out the límit of the intended conflagràtion; did you repeat your resolution of shortly leavìng Ròme, only putting it òff for a líttle, as you said, until you could have the head of the cònsul. Two knìghts—Ròman knights—promised to deliver that head to you before súnrise the next mòrning; but scarcely was this stygian counsel dissólved, when the consul

was acquáinted[1] with the result of the whòle. I doubled the guards of my hoùse; and, after announcing to a circle of the first men in the stàte—who were with me at the tíme—the very mìnute when these assassins would come to pay me their respécts, thát sáme mìnute they arrìved, asked for éntrance, and were denìed it.

Procèed, Catiline, in your hònourable career. Go where your déstiny and your desìre are driving you. Evàcuate the cíty[1] for a sèason. The gátes[1] stand òpen. Begòne! Whát a shàme[1] that the Manlian ármy[1] should look out so lòng for their general! Take àll your loving friénds alòng with you; or, if thát be a vain hope, take, at least, as many as you cán, and clèanse the city for some short time. Let the walls of Ròme[1] be the mediators between thée and mè; for, at présent, you are much too nèar me. I will not sùffer you. I will not longer undergò you.

Lucius Cátiline, awày! Begìn, as soon as you are áble, this shámeful and unnàtural war. Begin it, on yoúr part, under the shade of every dreadful òmen; on míne, with the sure and certain hope of safety to my coúntry, and glory to mў̀self: and when thís you have done, thēn dō Thōu, whōse āltar was first fōunded by the fōunder of our státe—Thóu, the stàblisher of this cíty, pour out thy vengeance[1] upon this mán[1] and all his adhèrents. Sàve us from his fúry; our public altàrs, our sacred tèmples, our hoùses, and household góds; our líberties—our lìves. Pursùe, tutelar god, pursùe them—these foes to the gods and gòodness—these plùnderers of I′taly—these assàssins of Rome. Eràse them out of thís life; and, in the néxt, let thy vengeance pursúe them, insàtiable, implácable, immòrtal!

MONCONTOUR.*

O weep for Moncontour! O weep for the hour
When the children of darkness and evil had power;

* Moncontour, a village of France, 25 miles north-west of Poictiers. Here the Protestants (Hugenots) suffered a defeat in 1569.

When the horsemen of Valois triumphantly trod
On the bosoms that bled for their rights and their God.

O weep for Moncontour! O weep for the slain
Who for faith and for freedom lay slaughtered in vain!
O weep for the living, who linger to bear
The renegade's shame, or the exile's despair!

One look, one last look to the cots and the towers,
To the rows of our vines, and the beds of our flowers;
To the church where the bones of our fathers decayed,
Where we fondly had deemed that our own should be laid.

Alas! we must leave thee, dear desolate home,
To the spearmen of Uri, the shavelings of Rome;
To the serpent of Florence, the vulture of Spain;
To the pride of Anjou, and the guile of Lorraine.

Farewell to thy fountains, farewell to thy shades,
To the song of thy youths, to the dance of thy maids;
To the breath of thy gardens, the hum of thy bees,
And the long waving line of the blue Pyrenees!

Farewell and for ever! The priest and the slave
May rule in the halls of the free and the brave;
Our hearths we abandon—our lands we resign—
But, Father, we kneel to no altar but thine.

MACAULAY.

LADY RANDOLPH LAMENTING THE DEATH OF HER HUSBAND AND CHILD.

[JOHN HOME, the author of the popular tragedy of "Douglas," was born near Ancrum, Roxburghshire, in 1724, and died in 1808. He was educated for the church, and on being licensed, was ordained minister of Athelstaneford, in East Lothian. His tragedy of "Douglas" was performed at Edinburgh in 1756, and gave such offence to the presbytery, that the author, to avoid ecclesiastical censure, resigned his living, and ever after appeared and acted as a layman.]

Ye woods and wílds, whose`melancholy glóom!
Accords with my soul's sádness, and draws forth
The voice of sòrrow' from my bursting heárt,
Farewéll a whìle, I will not léave you lòng;

For in your shàdes| I deem some spírit dwells,
Who, from the chiding strèam| or groaning óak,
Still hèars| and ánswers to Matilda's mòan.
O Doŭglas, Doúglas! if departed ghòsts
Are e'er permitted to review this wórld,
Within the circle of this wòod thou art,
And, with the passion of immórtals, hearest
My lamentàtion; hearest thy wretched wífe|
Wèep for her husband sláin, her ínfant lòst.
My bròther's timeless death| I séem to mourn,
Who perished wíth thee| on that fatal dày:
To thèe I lift my voice; to thèe| address
The pláint| which mórtal ear hath nèver heard.
O disregárd me not; though I am called
Anóther's now, my heárt| is whòlly thíne.
Incàpable of chánge, afféction| lies
Bùried, my Doúglas, in thy bloody gràve.

HOME.

THE HAND.

In many respects the organ of touch, as embodied in the hand, is the most wonderful of the senses. The organs of the other senses are passive; the organ of touch alone is active. The eye, the ear, and the nostril stand simply open: light, sound, and fragrance enter, and we are compelled to see, to hear, and to smell; but the hand selects what it shall touch, and touches what it pleases. It puts away from it the things which it hates, and beckons towards it the things which it desires; unlike the eye which must often gaze transfixed at horrible sights from which it cannot turn; and the ear, which cannot escape from the torture of discordant sounds; and the nostril, which cannot protect itself from hateful odours.

Moreover, the hand cares not only for its own wants, but, when the other organs of the senses are rendered useless, take their duties upon it. The hand of the blind man goes

with him as an eye through the streets, and safely threads for him all the devious ways: it looks for him at the faces of his friends, and tells him whose kindly features are gazing upon him; it peruses books for him, and quickens the long hours by its silent readings.

It ministers as willingly to the deaf; and when the tongue is dumb and the ear stopped, its fingers speak eloquently to the eye, and enable it to discharge the unwonted office of a listener.

The organs of all the other senses, also, even in their greatest perfection, are beholden to the hand for the enhancement and the exaltation of their powers. It constructs for the eye a copy of itself, and thus gives it a telescope with which to range among the stars; and by another copy on a slightly different plan, furnishes it with a microscope, and introduces it into a new world of wonders. It constructs for the ear the instruments by which it is educated, and sounds them in its hearing till its powers are trained to the full. It plucks for the nostril the flower which it longs to smell, and distils for it the fragrance which it covets. As for the tongue, if it had not the hand to serve it, it might abdicate its throne as the Lord of Taste. In short, the organ of touch is the minister of its sister senses, and, without any play of words, is the handmaid of them all.

And if the hand thus munificently serves the body, not less amply does it give expression to the genius and the wit, the courage and the affection, the will and the power of man. Put a sword into it, and it will fight for him; put a plough into it, and it will till for him; put a harp into it, and it will play for him; put a pencil into it, and it will paint for him; put a pen into it, and it will speak for him, plead for him, pray for him. What will it not do? What has it not done? A steam-engine is but a larger hand, made to extend its powers by the little hand of man! An electric telegraph is but a long pen for that little hand to write with! All our huge cannons and other weapons of war, with which we so effectually slay our brethren, are only Cain's hand made bigger, and stronger, and

bloodier! What, moreover, is a ship, a railway, a lighthouse, or a palace—what, indeed, is a whole city, a whole continent of cities, all the cities of the globe, nay, the very globe itself, in so far as man has changed it, but the work of that giant hand, with which the human race, acting as one mighty man, has executed his will!

When I think of all that man and woman's hand has wrought, from the day when Eve put forth her erring hand to pluck the fruit of the forbidden tree, to that dark hour when the pierced hands of the Saviour of the world were nailed to the predicted tree of shame, and of all that human hands have done of good and evil since, I lift up my hand, and gaze upon it with wonder and awe. What an instrument for good it is! What an instrument for evil! and all the day long it never is idle. There is no implement which it cannot wield, and it should never in working hours be without one. We unwisely restrict the term handicraftsman, or hand-worker, to the more laborious callings; but it belongs to all honest, earnest men and women, and is a title which each should covet. For the queen's hand there is the sceptre, and for the soldier's hand the sword; for the carpenter's hand the saw, and for the smith's hand the hammer; for the farmer's hand the plough; for the miner's hand the spade; for the sailor's hand the oar; for the painter's hand the brush; for the sculptor's hand the chisel; for the poet's hand the pen; and for the woman's hand the needle. If none of these or the like will fit us, the felon's chain should be round our wrist, and our hand on the prisoner's crank. But for each willing man and woman there is a tool they may learn to handle; to all these is the command, "Whatsoever thy hand findeth to do, do it with all thy might."

DR. GEORGE WILSON.

WILD FLOWERS.

Sweet nurslings of the vernal skies,
Bathed in soft airs, and fed with dew,
What more than magic in you lies,
To fill the heart's fond view?
In childhood's sports, companions gay,
In sorrow, on Life's downward way,
How soothing! in our last decay
Memorials prompt and true.

Relics ye are of Eden's bowers,
As pure, as fragrant, and as fair,
As when ye crowned the sunshine hours
Of happy wanderers there.
Fallen all beside—the world of life,
How is it stained with fear and strife!
In Reason's world what storms are rife,
What passions range and glare!

Ye dwell beside our paths and homes,
Our paths of sin, our homes of sorrow,
And guilty man, where'er he roams,
Your innocent mirth may borrow.
The birds of air before us fleet,
They cannot brook our shame to meet—
But we may taste your solace sweet
And come again to-morrow.

Ye fearless in your nests abide—
Nor may we scorn, too proudly wise,
Your silent lessons, undescried
By all but lowly eyes;
For ye could draw th' admiring gaze
Of Him who worlds and hearts surveys:
Your order wild, your fragrant maze,
He taught us how to prize.

Alas! of thousand bosoms kind
  That daily court you and caress,
How few the happy secret find
  Of your calm loveliness!
Live for to-day! to-morrow's light
To-morrow's cares shall bring to sight,
Go, sleep like closing flowers at night,
  And Heaven thy morn will bless.

KEBLE.

ELEMENTS OF MACHINERY.

Cylinder, (*kylindo*, G.) a roller; a long round body of uniform thickness, whose ends are equal and parallel circles.
Engine, (*ingenium*, L.) *Lit.* a clever contrivance. Hence also *ingenious*.
Fulcrum, (L.) a prop or support.
Lever, (*levo*, L.) *Lit.* the lifter or raiser.
Prime mover, (*primus*, L.) the original force which sets a machine in motion.
Pulley, (*polus*, L.) *Lit.* the turner or revolver.

OF MACHINES IN GENERAL, AND THEIR USES.

THERE are many kinds of force which men have employed for the purpose of producing motion. Thus, a common pump is worked by the hand; carts and carriages are drawn by horses; the motion of a clock is due to gravity acting on its weights; the downward flow of water is made to turn water-wheels; a windmill and a ship are driven by the wind; and, not to mention others of less importance, the elastic force of steam is the great moving power of our time. But it will often happen that none of these moving powers, or *prime movers*, as they are called, can be directly applied at the point where it is wanted; or it may act in a different direction from that in which we wish motion to take place; or, from various other causes, it may be difficult so to regulate its application, as to secure the exact accomplishment of the desired effect. Suppose that a heavy stone, for example, has to be raised twenty feet. It is impossible for any considerable number of men to get hold of

it, and, even if they could, it would be equally impossible for them to raise it farther than their arms can reach. But, by means of a contrivance called a crane, they will be able to accomplish their purpose without the least difficulty. This is only one out of innumerable cases in which some instrument or contrivance is necessary in order to modify a moving power, so as to adapt it to the performance of a particular kind of work. Now, every such instrument or contrivance is called a *machine.* Some simple machines, used by artizans or mechanics, are also called *tools;* and some others, of larger size and more complex structure, are often spoken of as *engines;* but the word "machine" is, properly speaking, applicable to them all.

It is not the purpose of a machine to *produce* motion, nor has it any power to do so. It cannot even move itself; and it will accordingly remain at rest, unless some moving power act upon it. But it transmits the force, communicated to it by a moving power, from one point to another, alters its direction or intensity, and, in general, turns it to the best account in the performance of any given work.

Hence we have always at least two things to consider in examining a machine, namely, the work to be done, implying a certain resistance to be overcome, and the force or *power,* by whose action on the machine that work is performed. The former is technically called the *weight.* Sometimes, indeed, weight is the actual resistance which has to be overcome, as, for example, in raising a stone or other heavy substance; but even when this is not the case, we still speak of the *power* and the *weight.* This cannot be said to be incorrect, for every kind of force or resistance may be conveniently represented by a weight exactly sufficient to produce the same effect.

Machinery is employed for an immense variety of purposes. By it many results are easily attained, which neither the hand nor any other moving power could directly accomplish. We owe to it much of our progress in civilization. Few of the comforts, the luxuries, or the ornaments

of life could become ours without its invaluable aid. It is the indispensable handmaid of all the useful arts—of agriculture, mining, manufactures, commerce, navigation. Even in the most common transactions of everyday life, machines are ever in our hands. The merchant uses a balance to weigh, and a knife to cut, the goods which a cart, or a steam-engine, has brought him. The balance, the knife, the cart, the steam-engine, are all machines. When we replenish the grate, we use a shovel or a pair of tongs; these are machines too. So is the poker with which we afterwards stir up the fire. The clock or watch which tells us the hour is a machine of great complexity; and scarcely less intricate, perhaps more so, is the printing-press with which this book was printed. Not to multiply examples unnecessarily, the motions of our own bodies are to a great extent mechanical, and certain parts of their structure, especially in the limbs, afford some of the best illustrations of the principles of machinery.

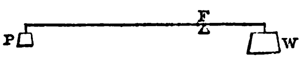
It has been said that no machine can of itself produce motion or create force, yet it may enable a comparatively feeble force, such as the muscular strength of a man, to overcome a resistance much greater than itself. How is this? Does the machine really add to the energy of the power? It does not, for the increase of power is gained at the expense of time. If the weight of a ton, for example, is to be raised one foot by a force equivalent to a hundred weight, the force must act through a space of twenty feet. So it is in every other case; the greater the weight is, when compared with the power, the smaller must be the space through which it will be moved by the motion of the power through any given space. In short, a feeble power will raise a heavy weight, but it will do it slowly in proportion to its feebleness.

There are certain simple elements of which all machines, however complex, are composed. They are called the *Mechanical Powers*. Of these there are usually reckoned six—the *lever*, the *wheel and axle*, the *pulley*, the *inclined plane*, the *wedge*, and the *screw*.

THE LEVER.

A LEVER is a solid rod or beam turning on a fixed axis, which is called the *fulcrum* or *prop*. It may be either straight or bent, but the straight lever is that which most frequently occurs, and whose effects are most easily understood. The delightful game of *see-saw* affords an example with which every boy is familiar. The fulcrum is the point on which the plank rests and round which it turns; the weight of either boy may be reckoned the power; that of the other is the weight. Here the fulcrum is between the power and the weight, and the power may be either less or greater than the weight, or they may be exactly equal. This is the most common kind of lever, and is usually called a lever *of the first kind*. P and W are the power and weight, acting at their respective ends of the lever of which F is the fulcrum; their distances from F are called the *arms* of the lever. The longer the arm P F is, when compared with the arm W F, the smaller will be the force P required to move or balance a given weight W. Thus if P is a force equal to 1 lb., and acts at a distance of one foot from F, it will balance a weight of 12 lbs. suspended at the distance of one inch on the other side of F. Hence power is gained in this kind of lever by moving the fulcrum towards the end at which the weight or resistance is to be overcome. But it is clear that it must be gained at the expense of time, for the weight will move through a shorter distance, and therefore more slowly than the power, in proportion as the arm which supports it is shorter than the other. When a quarrier employs a crow-bar to move a heavy stone, his hand is the power, and he places a small stone below the crow-bar as a fulcrum. The poker rests in the same way, on one of the bars of the grate, which is its fulcrum; the coals in the grate are the weight. A pump-handle is another familiar example of the same kind of

FIG. 27.



lever. Scissors, snuffers, and pincers are double levers of the first kind; the nail that unites the two parts of the instrument being the fulcrum of both.

We have a very important application of this class of levers in the various kinds of *balances* used for weighing goods. In the common balance, the arms are equal, so that the power and the weight, or rather the two weights, must also be equal, in order to secure equilibrium. The steel-yard differs from the common balance in having arms of unequal length, on the longer of which is marked a scale of divisions. A known weight (P) is slid along these divisions, until it balances the substance to be weighed (W). Its position on the scale will then indicate the weight of that substance.

Fig. 28.

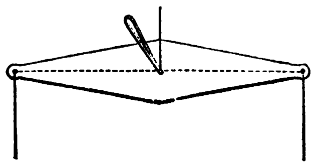
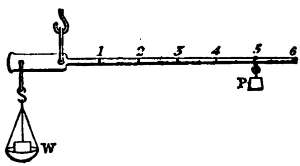
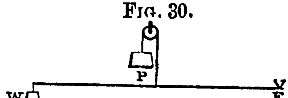


Fig. 29.



The *second kind* of lever has the weight between the fulcrum and the power. It is obvious that, in this case, the power will be always less than the weight, because it pulls by a longer arm, that is, at a greater distance from the fulcrum. It is equally clear that the power must move through a greater space than the weight, and therefore with greater speed. Hence this kind of lever is best adapted to produce an effect which requires great force rather than velocity of motion. An oar is a good example. The water against which its blade is pressed may be regarded as the fulcrum, the weight is the boat, and the hand of the boatman is the power. Gates and doors are often mentioned as examples of this kind of lever. A porter, rolling a heavy cask along the street, thrusts the point of a handspike below

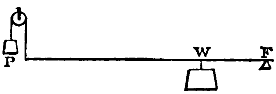
Fig. 30.



it, and shoves it from him, pressing it upwards. The earth is here the fulcrum; the power and weight are easily distinguished. Nut-crackers are double levers of the second kind. The hinge is the fulcrum of each half, the nut is the weight or resistance to be overcome, and the hand is the power.

In levers of the *third kind*, the power takes the middle place and, being nearer the fulcrum, must always be greater than the weight. Hence they are adopted only where rapidity and despatch are required more than power. One of the best examples is the treadle of a turning-lathe, in which the hinge is the fulcrum, the foot the power, and the crank of the wheel with which the treadle is connected the weight. Common tongs and the shepherd's shears are familiar examples of double levers of the third kind. Many striking examples are found in the animal economy. The limbs of animals are generally levers of this description. The forearm, for instance, has its fulcrum in the elbow-joint; the weight is the forearm itself and the hand, together with anything which they may be employed to move; and the power is a strong muscle proceeding from the shoulder, and attached to the forearm a little below the elbow. The advantage is, that a slight contraction of the muscle gives a considerable motion to the limb. Here, surely, we see displayed the goodness and wisdom of the Creator; for it is of much less consequence to man to be able to exert a great force or overcome a great resistance with his hand and arm, than to move these and the other members of his body with sufficient nimbleness and rapidity.

Fig. 31.

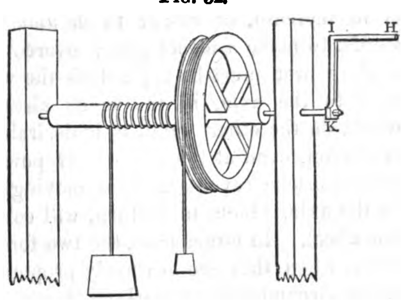


THE WHEEL AND AXLE.

Almost every one has seen a draw-well, into which the bucket is let down empty, and then drawn up full, by

means of a rope coiled round a cylinder. This cylinder is worked by a handle called a *winch* (H I K), and the hand which drives the winch makes one revolution for every coil of the rope. Suppose now that for the winch a wheel is substituted,* of such a size that its circumference may coincide with the circle described by the hand in working the machine. The apparatus will then be a *wheel and axle*, in the simplest form which it can assume. The cylinder, round which the rope is coiled, is called the *axle*.

Fig. 32.



In this, the second of the mechanical powers of which all machinery is composed, the moving power acts at the circumference of the wheel, and tends to make it revolve. The weight or resistance acts in the same way at the circumference of the axle, and pulls it round in the opposite direction to that in which the wheel is pulled. But the whole machine is either of one piece, or at least the wheel and axle are so connected, that if the one revolves, the other must revolve with it. Hence the power and the weight act against each other.

Suppose the circumference of the wheel to be ten feet, and that of the axle one foot. The weight, in one revolution, will thus pass through one tenth of the space described by the power in the same time; consequently it will be ten times as large as the power, if they are in equilibrium. A force of 1 lb., for example, will balance in the case supposed a resistance of 10 lbs. But it will be observed that the circumference of the wheel, which carries the smaller

* In the figure given above, there is *both* a wheel and a winch; but generally it is not necessary to have both in the same machine.

weight, moves ten times more rapidly than that of the axle, which carries the greater. Accordingly, where the object is to increase, or rather to *accumulate* power—in other words, to make a feeble power overcome a great resistance —the power must be applied to the wheel, and the resistance to the axle, in the mode already described. But when, on the other hand, it is desirable to secure velocity of motion, even at the expense of power, the order of the parts must be reversed. The moving power will then act on the axle, which, in its turn, will communicate motion to the wheel. In either case, the two forces will balance each other, when they are inversely proportional to the lengths of the circumferences in which they act.

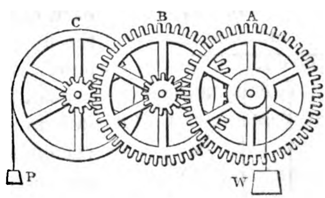
It may be remarked, that the principle of this machine is exactly identical with that of the lever. The common axis round which both wheel and axle turn, may be regarded as the fulcrum. The weight acts at a distance from that fulcrum equal to the radius of the axle, and the power at a distance equal to the radius of the wheel. Now, these distances form, as it were, the two arms of a lever of the first kind. Every successive instant, as the machine revolves, each of the forces acts at the extremity of a new radius, so that every conceivable radius, both of the wheel and axle, becomes an arm of the lever in its turn. Hence the wheel and axle has sometimes been called the *perpetual lever*.

We have an example of the wheel and axle in the apparatus used for steering a ship. In boats and other small vessels, the helm is moved by a lever, but in larger vessels a wheel and axle is employed. Hence we hear the helmsman spoken of as "the man at the wheel." In this case, the rim of the wheel is set round with handles for the helmsman to pull by; the chain that moves the helm is coiled round the axle. In practice, it is not always necessary that the wheel should be complete; for the same effect will be produced if spokes are inserted into the axle without being connected by a rim, and these may be turned by the hand, or by any other power acting at their extremities. This is the principle of the *capstan*, a powerful instrument

used in ships for hauling up anchors. The axle is a strong vertical cylinder, and is moved by the sailors pressing against the spokes, which are taken out and laid aside when the instrument is not in use. In one case already referred to, the wheel is wanting altogether, its place being supplied by a winch. The length of the rod or lever K I (fig. 32) is to be regarded as the radius of the wheel, and the circle described by the hand its circumference. This form of the machine is called a *windlass.*

When great power, or great velocity is required, wheels and axles are often combined so as to impart motion to one another. The modes of combination are extremely various. Sometimes a strap or cord is placed in a groove in the circumference of an axle, and carried round a similar groove in the circumference of a wheel. This is called an endless band. But the most common mode of connecting two wheels, or a wheel and an axle, is to surround the circumference of both with teeth or cogs fitting into each other. In this case, the axles are usually called *pinions,* and the teeth raised upon them are called *leaves.* Thus, in the system represented in fig. 33, the power moves the wheel C; the axle of that wheel is a pinion whose leaves fit into the teeth of the wheel B, and set it in motion; the axle of the wheel B, again, imparts motion, in the same way, to the wheel A. Now, if the wheel A has fifty teeth, and the pinion which drives it ten, the latter must evidently make five revolutions for every revolution of the former. The wheel B will therefore move five times as fast as the wheel A; and, on a similar supposition in regard to the wheel B and the pinion which drives it, the wheel C will be found to move five times as fast as the wheel B. By this system, then we lose velocity and time, but gain power. It is clear however, that the arrangement might be reversed, or

FIG. 33.



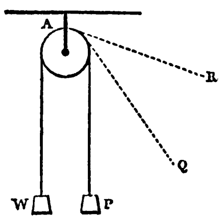
modified in a thousand different ways. It is, indeed, this same simple principle, which lies at the foundation of all the ingenious and often complicated machinery included under the general name of *wheel-work*.

THE PULLEY.

THE *pulley*, the third in importance of the mechanical powers, consists essentially of a cord passing over a wheel which turns on an axis. We often speak of the wheel as if it were itself the pulley, but it is upon the cord that the mechanical effect depends, the wheel being introduced to lessen the effects of friction. When the wheel merely turns on its axis, without moving from its place, it is said to be *fixed;* but when it is suspended by means of the cord, so as to rise and fall with the weight, it is called a movable pulley.

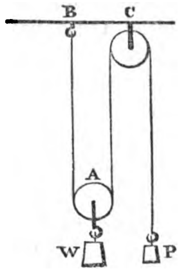
If the cord of the fixed pulley A have a weight suspended at each end, it is obvious that these weights, to balance each other, must be equal. Hence the fixed pulley gives no additional power, and therefore cannot enable a small force to overcome a greater. But its use is attended with this convenience, that it enables us to produce an upward motion, for example, by a downward force, or indeed by a force acting in any direction whatever. It is evident that a hand will have the same effect in raising the weight W, whether it act at P, or at Q, or at R. Thus, a moving power, of whatever kind, may, by the use of one or more fixed pulleys, produce a motion in any desired direction by acting itself in the direction in which it can be most conveniently applied.

FIG. 34.



A movable pulley, however, affords mechanical assistance. Suppose the weight W to be attached to the movable pulley A, and one end of the cord of the pulley fastened to a hook at B. If we fasten the other end to a similar hook at C, each hook will support one-half of the weight. But if, instead of being fastened at C, that end of the cord is either held by the hand, or passed over a fixed pulley, and stretched by a weight P, the hook at B will still support its half of the weight W, so that the weight P, or the hand which holds the cord, will have to support only the other half. If the hand now pull the string, the hook at B will continue to afford the same assistance. Hence the power of the hand will be doubled. But it is to be observed that the weight will move with only one-half the velocity with which the hand moves; for, in order to raise it one inch, the cord must be pulled till it is one inch shorter on each side of the pulley, that is, till the hand has moved through two inches. Thus the advantage of a movable pulley consists in dividing the difficulty. The weight is raised through a certain space, by pulling the cord through a space twice as great, but only one-half the strength is required which would be necessary without the aid of the machine. The effect is almost the same as if the weight were divided into two equal parts, and these parts raised successively.

FIG. 35.

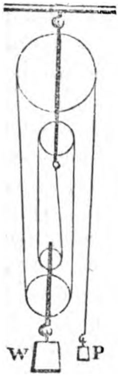


Here, then, we have another example of the principle on which all mechanical power is founded. The deficiency of strength in the moving power is compensated by superior velocity. In every machine, however powerful, and however ingenious, what is gained in power must be lost in time. It would be a great mistake, however, to suppose that the loss is equal to the gain, and that we derive no advantage from the mechanical powers. Since our strength is not great, and we cannot augment it, that science is of wonderful utility which enables us to reduce to its level any

resistance we may have to overcome, or any heavy body we may have to raise. This we accomplish very much in the same way as if we divided the body into parts, and raised these parts successively; but with this important difference, that, at the conclusion of our task, the body remains whole and uninjured. If it requires a sacrifice of time to attain this end by means of a machine, it must be remembered that without the machine it could not be attained at all. It is with great advantage, then, that time is thus exchanged for power.

If two or more movable pulleys be connected together, the effect will be increased. Sometimes one cord is passed round several wheels, as in the system represented in fig. 36. Here the weight is supported by four cords, or, to speak more correctly, by the four parts or folds into which the cord is divided by the wheels. The power P therefore supports only one-fourth of the weight W. For instance, a boy strong enough to lift 1 cwt., either without a machine, or by means of a fixed pulley, would be able, by such a system as this, to lift 4 cwt. There are other methods of arranging pulleys in which several distinct cords are employed. In these, the mechanical effect is still greater, but the apparatus is more complicated, and less convenient.

FIG. 36.



The pulley is chiefly used for the purpose of raising heavy bodies. It is by means of pulleys that the sailor hoists his sails. They are in this case doubly convenient; for, besides affording him mechanical assistance, they enable him to accomplish his purpose without leaving the deck.

THE INCLINED PLANE, WEDGE, AND SCREW.

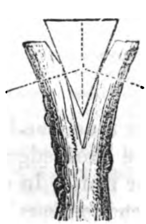
THE *inclined plane* is the simplest of the mechanical powers. It is a plain sloping surface, used for the purpose of moving weights from one level to another. Thus, if a heavy cask

has to be put into a cart, it may be difficult to lift it perpendicularly; but, by laying a broad plank in a sloping position, with one end resting on the ground, and the other on the cart, the difficulty is easily overcome. In this and similar cases, the power necessary for raising a weight, will bear the same proportion to the weight itself, as the perpendicular height, through which the weight has been raised, does to the length of the plane along which it has actually moved. By lengthening the plane, therefore, we render the work easier. Thus, on an inclined plane of 20 feet in length, and 4 feet in perpendicular height, a weight of 500 lbs. will be balanced by a force equal to 100 lbs. urging it up the plane. If the plane is 40 feet long, the height remaining the same, the same force will balance a weight of 1000 lbs. It is for this reason that we do not make a road right up a hill, but give it a winding course, so as to increase the length, and thereby lessen the difficulty of the ascent. Roads, it may be observed, are usually inclined planes, and the same may be said of railways, though both are in some parts horizontal.

FIG. 37.

The *wedge* may be considered as made up of two inclined planes united at their bases. The back of the wedge corresponds to the perpendicular height of the inclined planes of which it is composed; hence the mechanical advantage gained by it is in proportion as the breadth of the back is less than the lengths of the two sides added together. But in the case of this instrument, the friction is usually so enormous, that calculations based on the supposition of perfect smoothness are really of little or no value. The principal use of the wedge is for cleaving timber and other

FIG. 38.



hard substances. It is also employed, as well as the screw, to join the parts of machines firmly together; pins and nails being modified wedges, which are retained in their places by friction. Knives, and other cutting instruments in daily use among us, may be referred to the principle of the wedge.

The *screw*, as well as the wedge, is to be regarded as a variety of the inclined plane. It is in fact nothing more than an inclined plane rolled round a cylinder. A staircase winding round a pillar is a rough example on a large scale. If a piece of paper be cut so that its edge A C shall be in the position of an inclined plane, and then rolled round a pencil or other cylindrical body AB, the edge A C will form a spiral round the pencil, which will answer to the thread of a screw, as seen in the figure E F. Hence, in calculating the mechanical advantage which it gives, the screw may be treated exactly as an inclined plane. In practice, however, the power of this instrument is greatly increased by the handle which works it, and which is usually a lever or a winch.

Fig. 39.

It must never be forgotten that, in all the foregoing explanations, the effects of friction and other disturbing influences have been left out of account. The results arrived at, therefore, are by no means absolutely correct, but they may be taken, in most cases, as a pretty near approximation to the truth.

CONCLUSION.

Such are the leading principles of the science of machinery, the knowledge and application of which have done so much for man. In a savage state, ignorant of the arts which depend on mechanical combinations, he is exposed, without shelter, to the inclemencies of the weather; he is unable to

transport himself over seas and oceans, to visit other climes, and other tribes of his fellow-men; he lives in the desert, uncivilized and comfortless; the fertile soil over which he roams, is covered with thorns and briers and thickets, the haunts of beasts of prey; his enjoyments are little superior to those of the lion, the hyæna, and the elephant, while he is much their inferior in point of agility and strength. But when he has once discovered and applied the principles of mechanics, and introduced the practice of the useful arts, "the wilderness and the solitary place are made glad, and the desert rejoices, and blossoms as the rose." Cities are founded, and gradually rise to opulence and splendour; palaces and temples are reared; the damp cavern, and the rush-built hut are exchanged for the warm and comfortable apartments of a substantial mansion; ships are built, and navigated across the ocean; the treasures and productions of one country are made to supply the deficiencies of another; intercourse is opened up between the most distant tribes of mankind; commerce flourishes in all its departments; and machinery of every kind is constructed to facilitate the labour, and promote the enjoyments of man. True it is that we should aim at something higher, and better, and more noble than mere material prosperity; yet surely it must be in accordance with the purposes of our being, and with the will of the beneficent Creator and Governor of all, that we should turn to the best account, for our own welfare and happiness, those ample resources which His bounty has placed at our disposal.

QUESTIONS FOR EXAMINATION.

Name some of the chief moving powers. Why are machines necessary? What purposes do they serve? What is meant by the power and the weight? Is the word "weight" correctly applied here? Give instances of machines in common use. How does a machine increase the effect of a moving power, since it does not create force? Name the mechanical powers. What is a lever? How many kinds of levers are there? What is the difference between them? What is meant by the arms of a lever? Give examples of levers of the first kind—of the second—of the third. Describe the common balance—the steel-yard. Describe the mechanical action of the forearm. Give a familiar example of the wheel and axle. What is the condition of equilibrium in the wheel and axle? Show that this machine is virtually a lever. Describe the steering apparatus

of a ship—the capstan. What is a windlass? How are wheels connected so as to move one another? What is a pinion? How is velocity of motion obtained in wheel-work? What is a pulley? a fixed pulley? a movable pulley? What is the use of a fixed pulley? Show that a movable pulley doubles the effect of a moving power. Why is it advantageous to gain power at the expense of time? What is the effect of combining pulleys? Give examples of the inclined plane. What is the condition of equilibrium on the inclined plane? Why is a road up a hill made circuitous? What is a wedge? and for what used? Show that the screw is a variety of the inclined plane. Describe the effects of mechanical discovery in promoting civilization.

THE BONFIRE OF CRAIG-GOWAN.*

[WILLIAM S. DANIEL, a poet of considerable note, died recently in Edinburgh, where he was well known to the literary circle. He is the author of "Lays of the Crimean War" and other poems.]

A horseman sweeps at the dead of night
  Through the forest braes of Mar;
And headlong is his star-lit flight—
  The messenger of war!
Wildly panteth his foaming steed,
  Yet for brae nor banks stays he,
But flies, with a Highland eagle's speed,
  By the rushing waves of Dee.
In the cot the herd-boy lifts his head
  At the strange and startling sound,
And stares, with slumber's wondering dread,
  As the hoof-sparks flash around.
The roe-buck springs from his lonely lair
Beneath the birch-tree's branches fair,
  While down his sides the fear-drops stream;
And the white owl sails through the troubled air,
  Like the creature of a dream!

But on flies the steed, with flowing mane,
  On his dark and desolate track,
And proudly he champeth the useless rein,
  For Vict'ry rides on his glossy back!

* The news of the fall of Sebastopol (Sept. 1855) was conveyed to the Queen at Balmoral. On receipt of the intelligence, she immediately ordered a bonfire to be kindled on Craig-Gowan Hill, overhanging Balmoral Castle.

On to the gentle lady's halls,
Who wears old Scotland's crown;
And "Hurrah, hurrah," the horseman calls,
"Sebastopol is down!"
Swift as light
Is the tidings' flight,
And, with beating heart, but air serene,
'Neath the glorious stars of a Highland night,
Forth steps the Queen!

"Fire the pile on Craig-Gowan height!"
The fair Victoria cries,
While the triumph-glance of Britannia's might
Beams through her queenly eyes:
"Light the pile on Craig-Gowan height,
Light the mountain's head,
Till every peak 'neath my Highland sky
With the victory-fire is red!
Let it tell with its mighty tongue of flame
To Scottish heath and town,
That my foot stands on the proudest gem
Of the Russian tyrant's crown!

"Let it flush the glens with its glorious light,
Where my kilted lads were born,
Who led the fight
Up Alma's height,
On the dreadful battle-morn;
The men who nobly know to die,
But cannot learn to flinch or fly—
Who, on Balaclava's plain,
When the death-shot poured like rain,
Bore the waving feathers high
In face of Russia's chivalry;
And bade them in their might come on,
Till the fiery horsemen's shock
Broke like spray on granite rock,
Where my Highland bayonets shone!

"Oh! that yonder flame could light
The hill-tops of the world,
Till sighing and down-trodden Right
Its sunny flag unfurled—
Till, with the bonds of serfdom riven,
By his own triumphant sword,
Man proudly raised his eyes to heaven—
The freeman of the Lord!

"But fire the pile on Craig-Gowan height,
Light mountain, glen, and sky—
Right tramples on the throat of might—
Light, light the bonfire high!"

W. S. Daniel.

THE BATTLE OF BALACLAVA.

[Some vague differences as regards the religious toleration of their subjects had taken place between Nicholas, the late emperor of Rusia, and the Grand Sultan of Turkey. Britain and France failed by mediation to effect a reconciliation, and Nicholas invaded Turkey, in 1853, with a large army. Britain and France, acting as the allies of Turkey, in their turn despatched an army to the Crimea. The battle of Balaclava, one of the most spirited and exciting contests of the campaign, was fought on the 25th October, 1854.]

The cavalry who have been pursuing the Turks on the right are coming up to the ridge beneath us, which conceals our cavalry from view. The Heavy Brigade in advance is drawn up in two lines. The first line consists of the Scots Greys, and of their old companions in glory, the Enniskillen Dragoons, the second of the 4th Royal Irish, of the 5th Dragoon Guards, and of the 1st Royal Dragoons. The Light Cavalry Brigade is on their left, in two lines also. The silence is oppressive; between the cannon bursts one can hear the champing of bits and the clink of sabres in the valley below. The Russians on their left drew breath for a moment, and then in one grand line dashed at the Highlanders. The ground flies beneath their horses' feet; gathering speed at every stride, they dash on towards that *thin red streak*

topped with a line of steel. The Turks fire a volley at eight hundred yards, and run. As the Russians come within six hundred yards, down goes that line of steel in front, and out rings a rolling volley of Minie musketry. The distance is too great; the Russians are not checked, but still sweep onward through the smoke, with the whole force of horse and man, here and there knocked over by the shot of our batteries above. With breathless suspense every one awaits the bursting of the wave upon the line of Gaelic rock; but ere they come within a hundred and fifty yards, another deadly volley flashes from the levelled rifle, and carries death and terror into the Russians. They wheel about, open files right and left, and fly back faster than they came. "Bravo, Highlanders! well done!" shout the excited spectators; but events thicken. The Highlanders and their splendid front are soon forgotten; men scarcely have a moment to think of this fact, that the 93rd never altered their formation to receive that tide of horsemen. "No," said Sir Colin Campbell. "I did not think it worth while to form them even four deep!" The ordinary British line, two deep, was quite sufficient to repel the attack of these Muscovite cavaliers.

Our eyes were, however, turned in a moment on our own cavalry. We saw Brigadier-General Scarlett ride along in front of his massive squadrons. The Russians—evidently *corps d'élite*—their light blue jackets embroidered with silver lace—were advancing on their left, at an easy gallop, towards the brow of the hill. A forest of lances glistened in their rear, and several squadrons of grey-coated Dragoons moved up quickly to support them as they reached the summit. The instant they came in sight, the trumpets of our cavalry gave out the warning blast which told us all, that in another moment we should see the shock of battle beneath our very eyes. Lord Raglan, all his staff and escort, and groups of officers, the Zouaves, French generals and officers, and bodies of French infantry on the height, were spectators of the scene, as though they were looking on the stage from the boxes of a theatre. Nearly every

one dismounted and sat down, and not a word was said. The Russians advanced down the hill at a slow canter, which they changed to a trot, and at last nearly halted. Their first line was at least double the length of ours—it was three times as deep. Behind them was a similar line, equally strong and compact. They evidently despised their insignificant-looking enemy; but their time was come. At that moment, the bugles gave out the signal to charge; and as the Inniskillen Dragoons on the right and the Scots Greys on the left, seemed suddenly to flash up the intervening part of the hill, with a cry that thrilled through the hearts of the British and French hosts alike, the immense force of the enemy curved itself like a crescent to receive and envelop them—the wings advancing, and the centre line remaining firm. The brief shock was distinctly heard by the world of armed spectators on the plateau, as the sabres clashed and the horses met; but in an instant it was over. Right through the first line of the enemy, without having been even detained, the Greys and Enniskilleners had passed, and were seen with sabres on high, and reddened, riding at tremendous speed towards the very heart of the second Russian line. All behind them was ruin, and they broke what was still before them with the same irresistible violence. But the wings of the enemy's cavalry were closing in tenfold numbers around the diminished band of heroes, whose rear and flanks they overlapped, when the 1st Royals and 4th and 5th Dragoon Guards charged with equal splendour, impetuosity, and effect, making the victory complete.

THE CHARGE OF THE LIGHT BRIGADE.

[AN INCIDENT IN THE BATTLE OF BALACLAVA.]

Méanwhile, the bùsiness which the 600 sabres of the Light Brigáde were undertaking, excited the astònishment of the French and English armies on the pláteau, who noted the ominous bùgles. All ȩ́yȩs[1] were turned in breathless sus-

pénse upon the scène. The Rússians| had retrograded into a less spárse| and expansive òrder—their skìrmishers, the waving lines of their light hòrse, and a double horn of advanced field-bátteries| fórming, as it were, an immensely wide gàllery, on which the British cavaliers on their magnificent hórses| were preparing to rùsh. To the léft front of the Light Brigade| there was hostile artìllery; to their rìght front| there was hostile artillery; and they would have to swèep| along the rifle range of three of the redóubts| still in the hands of the ènemy. But thís was nòthing. Straight before those 600 devoted ríders| the whole of the Russian càvalry, now re-united "in six massive divìsions," and pausing upon their own resérves (altogether at least 3000 stróng), were drawn up diàgonally| across the great gallery of raking fíre which we have described, but fárther in advànce. Would àny of the daring assáilants| ever even rèach them? But thís, again, was nòthing. Behínd| frowned thirty heavy gùns| along a regular líne| of six enormous battalions of ìnfantry, over whose heads in the réar| thùndered their great position-batteries from the hílls| oùt of which the assailants had originally deboúched, and ón which| they were now resting again| in complete battle arrày; a whole àrmy, in short, of 30,000 mén| impregnably pòsted, and holding in possession éverything| which our glorious Six Húndred| could attempt either to take awáy or assàil. One word mòre remains to be said: before the little bànd| who had to make their desperate oútset| could come to one stroke of the sàbre| or one thrust of the lánce, *they had to clear a mile and a hálf of gròund.* The immortal règiments, whose lot it was thús, in all the pomp of wàr, but without óne of the military chances of vìctory, to ride rejoicing like bridegrooms into the embrace of déath, were the 4th and 13th Light Dragòons, the 17th Làncers, the 11th Prince Albert's Hussárs, and the 8th (the King's Royal) Irish Hussars. Thèir task, it will be thus understóod, formed a melancholy contrast to thát| just undertáken| and accomplished by their còmrades.

Swerving a little to their own lèft| to get clearer spáce,

this hándful of horsemen| broke away supérbly upon their appalling èrrand, their comrades and allies on the heíghts watching the mòvement, first with wónder and even incredùlity, then with absolute consternátion and boundless hòrror. Cries of astonishment and dismáy| rose throughout the whole càmp—the two Commanders-in-Chiéf| were lost in àwe—none could co-operate with these horsemen nów; they were pàst help. Let us fòllow them. Fírst, the redoùbts opened with rifles and músketry upon their rìght; but, not turning a glance| either to òne side| or to the óther, they were soon borne pást by their spèed, which visibly incréased as they advànced. Every plúme| streaming bàck, every héad| bent slightly fòrward, every ríght arm| alòft, every hòrse| at grand racing stríde, swift as a mèteor, the pàgeant of real báttle, they flew ònwards.

When they had cleared more than hàlf the distance|.which had séparated them from the huge columns of Russian càvalry| forming the nearest portion of the enemy befóre them, and whén, of the mile and a hàlf, much less than three-quàrters of a mile intervéned, a blaze of líght| burst along the frònt, faint bluish wreaths of smóke| rose into the àir| behind the íntervals in the Russian squàdrons, obscuring the viéw of the Russian infantry màsses, and at the same móment| the first line of the careering brigàde, so regular befóre, appeared like a line no lónger, but all ravaged with gàps; men were seen lying on the groúnd| while their horses whéeled and fled bàck; òthers, on the cóntrary, were seen extricating themselves from the chárgers| which had fàllen: a moment móre| and the thunders of the artìllery| which had máde this devastation| were borne to the éars of the excited càmp. But stíll| the charge was not chècked, and òn rode the survívors| straight upon those murderous Russian gúns, into the very eỳes of a storm of musketry| from the army of foes behínd them, and amid anóther| but now doúble cannonade| on both sides of their advánce—from the position-batteries of the hills. Dífferent, indèed, was thís manner of executing a chàrge; dífferent, indeed, was thís style of cavalry fighting, from that of the fifteen

hundred Russian hórse' who on that very mòrning' had declined to meet the narrow front of a single regiment of Híghlanders' in a single lìne, unsuppórted, and only two dèep! How truly stàrtling the cóntrast—how unspéakable the dìfference!

After riding beyond the gùns, cutting down the gùnners, breaking and shattering a column of infantry, and dispersing the cavalry' that rode to the résoue, the heroes túrned' to charge hòme again, their gory and streaming sábres' no longer giving báck the same flashes to the sùn, and they thémselves' showing but òne man to every thrée' who had gallopped, five mìnutes before, from beneath the heíghts of the allied circumvallàtion. Alàs! dreadful as appeared such a change of númbers, the fúll alteration was not yèt. Anòther tremendous double hurricane of shót, which, coming from opposite quàrters, seemed to meet in their pérsons, pàssed among them as they túrned, and half their remaining fórce' vanished on the spòt. Then part of the Russian hòrse—a cloud of Cossack lánces—closed ìn, and interposing on their róad, not only seemed to bár it, but helped with the smòke' to hide them complétely' from the anxious gáze' of their comrades in the càmp.

Among thèse' it was a solemn móment' when they thus mentally said farewéll' to every rémnant of the nóble Light Brigàde! But a strange ínterest' rivetted every look stìll' upon the blocked-up pláin, and a stranger spéctacle' rewàrded that interest. Swíft, sùdden, stròng, and míghty was that pounding cràsh' which, as with a báttering-ram, swung open the centre of the Cossack lìne, and flung its folds in shivering fragments on either síde, as the Light Brigàde' came charging báck' and clèaving their terrible ávenue home. It was indéed the rèmnant of the British córps' which had looked so magnìficent' and so glíttering a few short mìnutes before. Blòody, làcerated, and grim with the sweat and smoke of the báttle, about a hùndred were seen together; and nearly as many móre' straggled into the camp before èvening. Thèse' were the survívors of the 607!

Such was the cóurse, and such was the clòse of that extraordinary chárge, whích, as General Sir William Nàpier afterwards justly remárked, was undertàken with so much *good will*, that "a doubtful sign, rather than a clear and unmistakable órder," had suffíced' to set it in mòtion. Our allíes' were lost in mingled sórrow and amàzement; and General Canrobèrt decláred' that the fèat, if it transgressed all the great rules of warlike prúdence, àlso transcended all the conceivable límits of warlike hèroism. *Compiled.*

THE CHARGE OF THE LIGHT BRIGADE.

Half a league, half a league,
Half a league onward,
All in the valley of death
   Rode the Six Hundred.
"Forward, the Light Brigade!
Charge for the guns!" he said:
Into the valley of Death
   Rode the Six Hundred.

"Forward, the Light Brigade!"
Was there a man dismayed?
Not though the soldier knew
   Some one had blundered:
Theirs not to make reply,
Theirs not to reason why,
Theirs but to do and die:
Into the valley of Death
   Rode the Six Hundred.

Cannon to right of them,
Cannon to left of them,
Cannon in front of them,
   Volleyed and thundered;
Stormed at with shot and shell,
Boldly they rode and well;
Into the jaws of Death,
Into the mouth of Hell,
   Rode the Six Hundred.

Flashed all their sabres bare,
Flashed as they turned in air,
Sabring the gunners there,
Charging an army, while
  All the world wondered;
Plunged in the battery smoke,
Right through the line they broke:
  Cossack and Russian
Reeled from the sabre stroke
  Shattered and sundered:
Then they rode back, but not—
  Not the Six Hundred.

Cannon to right of them,
Cannon to left of them,
Cannon behind them,
  Volleyed and thundered;
Stormed at with shot and shell,
While horse and hero fell,
They that had fought so well
Came through the jaws of Death,
Back from the mouth of Hell,
All that was left of them,
  Left of Six Hundred.

When can their glory fade?
O the wild charge they made!
  All the world wondered.
Honour the charge they made!
Honour the Light Brigade!
  Noble Six Hundred! TENNYSON.

ENGLAND'S DEAD.

SON of the ocean isle! where sleep[1] your mighty dead?
Show me what high and stately pile[1] is reared o'er Glory's bed.
Go, stranger, track the deep, free, free the white sail spread!
Wave[1] may not foam, nor wild wind[1] sweep, where rest not[1]
  England's dead.

On Egypt's burning plains, by the pyramid o'er-swayed,
With fearful power the noon-day reigns, and the palm-trees yield no shade.
But let the angry sun from heaven look fiercely red,
Unfelt by those whose task is done! — *there* slumber England's dead!

The hurricane hath might along the Indian shore,
And far by Ganges' banks at night is heard the tiger's roar;
But let the sound roll on! it hath no tone of dread
For those that from their toils are gone;—*there* slumber England's dead.

Loud rush the torrent-floods the western wilds among;
And free, in green Columbia's woods, the hunter's bow is strung;
But let the floods rush on! let the arrow's flight be sped!
Why should *they* reck whose task is done?—*There* slumber England's dead.

The mountain-storms rise high in the snowy Pyrenees,
And toss the pine-boughs through the sky, like rose-leaves on the breeze;
But let the storm rage on! let the fresh wreaths be shed!
For the Roncesvalles' field is won,—*there* slumber England's dead.

On the frozen deep's repose 'tis a dark and dreadful hour,
When round the ship the ice-fields close, and the northern night-clouds lower;
But let the ice drift on! let the cold blue desert spread!
Their course with mast and flag is done,—even *there* sleep England's dead.

The warlike of the isles—the men of field and wave—
Are not the rocks their funeral piles? the seas and shores their grave?
Go, stranger, track the deep, free, free the white sail spread!
Wave may not foam, nor wild wind sweep, where rest not England's dead.

MRS. HEMANS.

STORY OF THE BOAR AND TWO LIONS.

In the days of my youth, when a black moustache curled where now you see the hoary beard of my winter's age, I seldom passed a night within my father's hut; but sallying out with my gun, lay in wait for the wild animals which frequented a neighbouring forest. One moonlight night I had taken my position on a high rock, which overhung a fountain and a small marsh, a favourable spot with our hunters to watch for boars, who resorted thither to drink and root. The moon had traversed half the heavens, and I, tired with waiting, had fallen into a dose, when I was roused by a rustling in the wood, as on the approach of some large animal. I raised myself with caution, and examined the priming of my gun ere the animal entered the marsh. He paused and seemed to be listening, when a half growl, half bark, announced him to be a boar, and a huge beast he was, and with stately step he entered the marsh.

I could now see by the bright moon, as he neared my station, that his bristles were white with age, and his tusks gleamed like polished steel among the dark objects round him. I cocked my gun, and waited his approach to the fountain.

Having whetted his ivory tusks, he began to root; but he appeared to be restless, as if he knew some enemy was at hand; for every now and then raising his snout, he snuffed the air.

I marvelled at these movements, for as the breeze came from a quarter opposite to my position, I knew I could not be the object of the boar's suspicions. Now, however, I distinctly heard a slight noise near the edge of the marsh: the boar became evidently uneasy; he once or twice made a low moan, and again began to root.

Keeping a sharp look out on the spot whence I heard the strange noise, I fancied I could distinguish the grim and shaggy head of a lion crouching upon his fore paws, and, with eyes that glared like lighted charcoal through the bushes, he seemed peering at the movements of the boar.

I looked again, and now I could see plainly a lion creeping, cat-like, on his belly, as he neared the boar, who was busy rooting, but with bristles erect, and now and then muttering something that I could not understand.

The lion had crept within about twenty feet of the boar, but was hidden in part by some rushes. I waited breathless for the result; and, although myself out of danger, I trembled with anxiety at the terrible scene.

The boar again raised his snout, and half turned his side towards the lion, and I fancied I could see his twinkling eye watching the enemy. Another moment, and the lion made a spring, and was received by the boar, who reared up on his hind legs. I thought I could hear the blow of his tusks as the combatants rolled on the ground. Leaning over the rock, I strained my eyes to see the result. To my surprise the boar was again on his legs, and going back a few paces, rushed at his fallen foe: a loud yell was given by the lion, which was answered by the distant howlings of the jackals. Again and again the ferocious boar charged till he buried his very snout in the body of the lion, who was kicking in the agony of death. Blood indeed flowed from the sides of the boar, and his bristles still stood erect as he triumphed over the sultan of the forest, and now he seemed to be getting bigger and bigger. "God is great!" said I, as I trembled with dread: "he will soon reach me on the rock." I threw myself flat on my face, and cried out, "There is no other God but God, and Mohammed is his prophet!" I soon recovered my courage, and looked again. The boar had returned to his natural size, and was slaking his thirst in the fountain. I seized my gun, but, reflecting, said within myself, "Why should I kill him? He will not be of any use to me; he has fought bravely, and left me the skin of a lion, and perhaps he may be a Jin:"* so I laid down the gun, contenting myself with thoughts of the morrow.

The boar had left the fountain, and was again busied rooting in the marsh, when another slight noise, as of a rustling in the wood, attracted my notice, and I could perceive the

* An evil genius or spirit.

smooth head of a lioness looking with surprise and horror at the body of her dead mate.

She advanced boldly. The boar stood prepared, grinding his teeth with rage. She paused, retreated to the wood, and again stopped, and, lashing her tail, roared with a voice that the whole wood re-echoed.

The boar stamped his hoofs, and gnashed his tusks again with rage; his grisly bristles, red with the blood of her mate, stood on end; then, lowering his snout, he rushed headlong against the lioness, who, springing aside, avoided the dread blow. A cloud came over the moon; I could not see distinctly, but I heard every blow of the paw and every rip of the tusk. There was a dead silence: again the cloud had passed, and the heavens were clear, and I saw the lioness with her fore paws on the body of the boar.

I seized my gun and aimed at her head; that was her last moment. The morning dawned. I descended from the rock. The claw of the lioness still grasped in death the body of the boar. Many severe wounds showed that the boar had again fought bravely.

The lions were the finest I ever saw, and I made good profit by that night's work.

HAY.

THE MECHANICAL PROPERTIES OF LIQUIDS.

Alcohol, spirits of wine. (An Arabic term.)

Aqueduct, (*aqua*, *duco*, L.) a huge pile of arches, built by the ancients for carrying water over valleys.

Area, (L.) the surface contained within any lines or boundaries.

Elastic, (*elauno*, G.) springy. Hence also *inelastic*, *elasticity*.

Fluid, (*fluo*, L.) *Lit.* flowing, or capable of flowing. (A term including both liquids and gases.)

Paradox, (*para*, *doxa*, G.) an apparent impossibility; an assertion which seems contrary to reason.

Piston, (F.) the sucker of a pump; a small cylinder sliding in the hollow of a larger one.

Specific Gravity is the weight of a body, compared with that of an equal bulk of other bodies. Hence *specifically*.

PRESSURE OF FLUIDS.

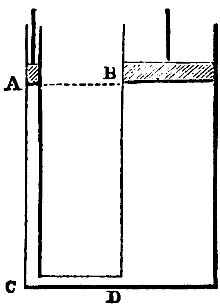
LIQUIDS and gases are often called *fluids*, because their particles, having little or no mutual cohesion, move freely among one another. Thus, water is a fluid, and air is

also a fluid. Sometimes we hear gases spoken of as *elastic* fluids, to distinguish them from liquids, which are then regarded as *inelastic;* but this is not quite correct, for all fluids have some elasticity. Air, however, and the other gases, are much more elastic than liquids, such as water.

When force is applied to a solid body, it is communicated from particle to particle only in one direction. But in this respect fluids are altogether different. One of their distinguishing characteristics is, that *they transmit pressure equally in all directions.* Every particle presses on all those around it with equal force, and with equal force is pressed upon by them. With exactly the same force does it press on any solid body which it touches, and, action and reaction being equal, the solid returns a pressure equal to that which it receives.

From this principle we have some very curious results.

FIG. 40.



Suppose a vessel A C D B, the lower part of which is filled with water or any other liquid. If a water-tight *piston* be pressed downwards upon the surface of the water at A, the pressure so applied will be transmitted undiminished to every part of the surface of the vessel. If the lower surface of the piston at A have an area of one square inch, the pressure it communicates to the water will produce an equal pressure on every square inch of solid surface with which the water is in contact. Suppose now that a similar piston is inserted in the larger limb of the vessel, as at B, and suppose that its under surface has an area of 10 square inches. Then the whole upward pressure which the water exerts on the surface of the piston at B will be ten times the downward pressure applied to the piston at A. If the latter be made small enough, or the former large enough, a prodigious pressure may thus be produced by a comparatively feeble force. This is the principle of

the Bramah press (so named from its inventor) by which such wonders have been wrought. The piston at A is attached by its rod to a lever, which is worked by the hand or any other moving power; the weight or resistance to be overcome is connected with the rod of the piston at B. By using a machine of this description, of little more than the size of a tea-kettle, a man is enabled to cut through a thick bar of iron as easily as he could clip a piece of pasteboard. A force of 500 or 600 tons may in this way be brought to bear on any substance which we wish to press, to tear up, to cut to pieces, or to pull asunder. It was by such a machine, though of much greater size and power, that the tubes of the Britannia railway bridge, across the Menai Straits, were raised to their present position.

A similar effect will be produced, if, instead of having a piston at A, the limb A C be continued upwards, and filled with water. The weight of the water above A will cause a pressure at that point, which will be transmitted and multiplied, as already explained. Supposing the two limbs to have the same width as before, the upward pressure on the piston at B will be ten times the weight of the water above A. In other words, the pressure on the piston at B will be equal to the weight of a quantity of water sufficient to fill the wider limb to the same height at which the water stands in the other. And this last result will be equally true, however small the limb A C, or however large the limb B D. In short, the pressure of water upon any surface does not depend at all upon the bulk of the water, but only on the area of the surface against which it presses, and its own height above that surface; so that *a very small quantity of water may overcome an enormous resistance.* This is one form of what has usually been called the *hydrostatic paradox.* If, for example, a small strong pipe be fixed in the bunghole of a barrel full of water, and water poured in till it rises in the pipe to a sufficient height, the barrel will burst, although a very small quantity of water may have been required to fill the pipe. Nor does it matter in the least whether the pipe be straight or crooked, round, square, or

irregular in shape; nor, on the other hand, whether the surface exposed to the pressure be horizontal, slanting, or vertical; the extent of that surface, and the perpendicular height to which any part of the water rises above it, are the only things to be considered in calculating the effect. Hence it is easy to conceive how a little water may often be productive of much mischief. Suppose a pool of water in the bowels of a mountain, with a very small chink or fissure extending down to it from above; if that chink were to be filled with rain to a great height, the mountain might be shaken, perhaps rent in pieces with the greatest violence. Some of the most dreadful devastations have resulted from this cause.

It follows naturally from all that has been explained, that, if both pistons be removed from the vessel represented in fig. 40, the water will rise in both limbs to the same height. Without this there could not be equilibrium. This result will not be affected by the shape, size, or number of the limbs; the free surface of the liquid, when at rest, will be everywhere at one common level. If a pipe be laid across a valley, water running in at one end, after filling all the lower part, will rise at the other end to the same level at which it enters the pipe. This is a principle of great importance in conveying a supply of water to cities, and even to single houses. A reservoir is provided on a level a little higher than the highest point at which the water is required; and then it does not matter how far below that level any intervening portion of the pipe may have to lie, provided only it be strong enough. The water, however far it may have descended, will rise again to the level of its surface in the reservoir, and will rush out at any opening below that level. With this important application of the principles just explained, it appears probable that the ancients were unacquainted; hence those stupendous works called *aqueducts*, many of which still remain, more or less entire, as a monument at once of their ignorance of the laws of fluid pressure, and of their vast attainments in some other departments of mechanical science.

FLOATING BODIES.

When a solid body is plunged into a liquid, it displaces, if wholly submerged, a quantity of the liquid equal to its own bulk. Now, if the solid be of the same weight with the liquid so displaced, it is clear that it will remain at rest anywhere beneath the surface, neither rising nor falling, because the liquid itself, whose place it occupies, would thus have remained at rest. If the solid is heavier than the displaced liquid, it will sink to the bottom; but, if it is lighter, it will rise to the surface.

In order, therefore, that a solid body may float in any liquid, it is necessary that, bulk for bulk, it be not heavier than that liquid. Thus a piece of glass floats in quicksilver, but sinks in water; a piece of ebony floats in water, but sinks in alcohol. Suppose now that, by way of example, we throw a cork into a basin of water. It will be observed that it does not simply rest on the level surface, but is partially immersed, displacing a quantity of the water less than its own bulk. But why does it not sink farther? The force which supports it, and counteracts the tendency of its weight to make it descend, is the upward pressure of the water on the part immersed. That pressure must therefore be equal to the weight of the cork. Now, if the cork were removed, and the hollow it makes in the surface of the water were filled with the liquid itself, it is clear that there would still be equilibrium. The pressure, therefore, which supports the cork, is such as would exactly support the water necessary to fill the hollow made by it, and is therefore equal to the weight of that water. It follows from this, that the weight of the cork, and the weight of the water it displaces, are the same; for both are equal to the pressure by which the cork is prevented from sinking. The same thing is true of every solid body floating on the surface of a liquid; the liquid it displaces, though less in bulk, must be equal to it in weight. Hence, the heavier a body is, the greater will be the part of it immersed. A ship, for example, sinks the deeper, or draws the more water, the more heavily it is

laden. On this principle, the total weight of a floating body, such as a ship, may sometimes be easily ascertained. For, if we can find how many cubic feet of the hull are below the level of the water's surface, we have only to calculate the weight of the same number of cubic feet of water, which will also be the weight of the whole vessel, including masts, sails, cargo, and all that she carries or contains.

The body of a living man is very nearly equal in weight to its own bulk of water. Being generally, however, a little lighter, it will float safely in still water, if placed and kept in such a position as to be all submerged except the face. Unskilful persons, in attempting to do this, are apt to plunge and struggle, tossing their arms out of the water, so that less of the liquid is displaced; the head consequently sinks to restore equilibrium; they then take in water at their mouths and nostrils, which, expelling the air in their bodies, increases their weight without a corresponding increase in their bulk, till at last they become heavier than the water displaced, and inevitably go down.

The bodies of some species of animals, such as water-fowl, are much lighter than the same bulk of water. Fishes, again, have the power of changing their bulk, by distending an air-vessel or bladder contained within their bodies. This they accomplish by filling it with a kind of gas, different in different species, which they generate by means of an apparatus given them for the purpose. In this way, they can render themselves at will lighter or heavier than their own bulk of water, and so rise to the surface or sink to the bottom. Surely nothing could demonstrate more clearly the wise forethought of the Creator, than this adaptation of the inhabitants of the waters to the element in which they are to live.

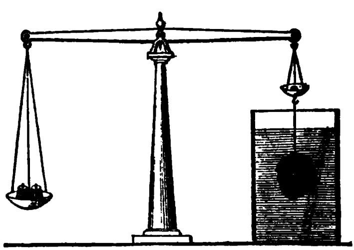
SPECIFIC GRAVITY.

It has been shown that a body floating in water is supported by a pressure equal to the weight of the water it displaces.

A body wholly submerged, whether heavy or light, will be subjected to a similar pressure. It will be urged upwards by a force equal to the weight of a quantity of water sufficient to fill the space which it occupies; that is, of a quantity of water of the same bulk as itself. Hence a heavy body immersed in water will weigh less than it does out of the water, the difference being equal to the weight of the water it displaces. For example, a block of stone or other heavy substance is more easily raised at the bottom of the sea than it would be on land; because it is lighter than it would be on land by the weight of its own bulk of sea-water. Thus it is that persons, engaged in building piers and other subaqueous works, find themselves endowed with a kind of supernatural strength, so that they can easily lift, and adjust in their places, masses of stone which on land they would vainly endeavour to move.

The principle which has just been explained, affords a convenient method of finding what is called the *specific gravity* of different substances. By this term we mean simply the weight of a body compared with that of another body of the same size. Properly speaking, all weight is comparative; mahogany, for example, is a heavy substance compared with cork, but light when compared with stone. Even stones are light when compared with some of the metals. Thus our notions of light and heavy are vague and undefined, and some standard of comparison is required, to which the weight of all other substances may be referred. The substance which has usually been adopted for this purpose is water; and therefore, when we speak of the specific gravity of a body, it is its weight, compared with the weight of an equal bulk of water, which is usually implied. Suppose now,

Fig. 41.



for example, that we wish to find the specific gravity of some kind of precious stone, of which we have only a small, irregularly shaped specimen. Let it first be weighed carefully, and then, having been suspended in water by a thread (as in fig. 41) attached to one of the scales, let it be weighed again. The loss of weight at the second trial will be the weight of a quantity of water equal in size to the stone; and, the weight of the stone itself being known, its specific gravity is easily calculated. The same method is also applicable, in a modified form, to solids specifically lighter than water.

This mode of finding specific gravities is believed to have been discovered by Archimedes, a philosopher of Syracuse, about 200 years before Christ. The story goes that Hiero, king of Syracuse, had employed a goldsmith to make a crown for him, and had given him a mass of gold for that purpose. He suspected that the workman kept back part of the gold, and alloyed the crown with copper to make up the weight. But how was this to be proved? The question was referred to Archimedes, who long tried in vain to hit upon some mode of arriving at the truth. At last, being one day in the bath, he noticed how his body displaced the water and was buoyed up by it; and the thought suddenly struck him that if the crown were alloyed with a metal lighter than gold, it must be more bulky than a mass of gold of the same weight, so that he could detect the imposture by weighing it against such a mass in water. Elated beyond measure by his discovery, he rushed out of the bath, and ran home naked as he was, exclaiming in the Greek language, "Eureka! Eureka!" (I have found it! I have found it!)

CAPILLARY ATTRACTION.

It was explained in a former lesson that the free surface of a liquid at rest is everywhere at the same level, whatever be the size or shape of the vessel which contains it. But, though this is the general rule, there is one important and

remarkable class of cases, which may be said to form an exception. If we take a tube of glass with a very small bore, open at both ends, and dip one end into a vessel of water, the water will rise and remain in the tube at a considerable height above the level of the water outside; and the upper surface of the water which thus rises in the tube will be concave instead of horizontal. On examining more minutely, we shall find that a thin film of the water in contact with the outside of the tube is also a little higher than the rest of the water in the vessel. And further, round the whole edge of the water, where its surface meets the surface of the vessel containing it, the same thing may be observed; the liquid surface curves upwards as it approaches very near the solid. It is presumed, therefore, that there exists a certain attraction between the solid body and the liquid particles near it, which causes the latter to rise, in opposition to the force of gravity. This has been called *capillary* attraction, because its effects were first observed in tubes with very fine *hair-like* bores, though it is not by any means confined to such tubes.

That there really is an attraction, at least in some cases, between solids and liquids in contact, may be easily shown in another and very simple way. If the hand, for example, be plunged into water, and drawn out again, it will be quite wet; that is, its surface will be coated over with a thin film of water, which will continue to adhere to it, notwithstanding the tendency of gravity to make it fall off. There must, therefore, be an attraction between the surface of the hand and the molecules of the water, sufficient to overcome the weight of these molecules. If, however, the hand be dipped in quicksilver, it will be found, on withdrawing it, that it is perfectly dry. Not a particle of the quicksilver will adhere to it. There may, notwithstanding, be some attraction between the hand and the quicksilver, but, if there is, it is not so powerful as in the case of water. Suppose now that we dip a piece of glass in water, and then in quicksilver. The result will be the same as before; the water will wet the glass, the quicksilver will not. But we must not suppose,

as we are very apt to do, that water will thus wet any solid body which may be immersed in it, for there are some substances from which water runs off, leaving them dry, exactly in the same way as quicksilver runs off a piece of glass. If the hand itself be rubbed over with a little grease, water will not readily adhere to it. On the other hand, if a sovereign, or any other piece of gold, be dipped in quicksilver, it will be found, when taken out again, to be covered with a thin white coating of that liquid. This, then, is the general result at which we arrive, that certain liquids are attracted so powerfully by certain solids, that they will adhere to these solids in spite of gravity; while, in other cases, if there be any attraction, it is not strong enough to produce the same effect.

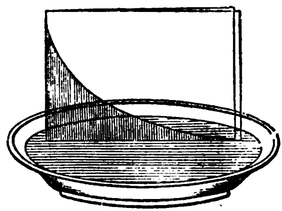
Now this distinction between a solid which is, and one which is not, wetted by any given liquid is of great importance in connection with capillary attraction. For it is not in all cases true that a liquid rises in a capillary tube higher than its level outside. It has been already stated that water does so in a capillary tube of glass; but then glass is one of the substances which water will wet. If the same tube be dipped into a vessel of quicksilver, or any liquid which does not wet glass, the result will be quite different; the quicksilver will stand lower in the tube than it does outside, and will have its upper surface convex, instead of concave. Round the outside of the tube, too, the liquid surface will curve downwards as it approaches very near the solid. And the same thing is true generally. If the solid with which a liquid is in contact is one which that liquid will wet, capillary attraction will cause the liquid to rise; but if otherwise, the liquid will not be raised, but depressed.

The height to which a liquid rises in a capillary tube depends on the diameter of the bore. The finer the bore, the farther will the liquid ascend. But capillary attraction, as already remarked, is not confined to tubes. If we take two plates of glass, and hold them in water very near each other, the water will rise between them, just as it would rise in a tube; and it will rise higher and higher in propor-

tion as the space between the plates is diminished. This may be beautifully shown by holding the plates in such a way as to touch each other at one side, with a very small space between them at the other side. The water will rise highest at the side where they touch, and gradually lower and lower as they diverge, its surface thus forming a curve somewhat like that represented in fig. 42.

There are many illustrations of capillary attraction in phenomena with which we are all familiar. Why, for instance, does the whole of a lump of sugar become gradually wet, when the least part of it is dipped in water? Simply because its pores act like so many capillary tubes, through which the water ascends. It is for a similar reason that the ground-floor of a house is so often damp, unless the site is naturally very dry, or thoroughly drained. Look at the wick of a lamp, always wet with oil, though the store of oil is considerably below it. The oil must be constantly oozing upwards through its porous substance by capillary attraction. The same principle partly accounts for the ascent of the sap in trees and other vegetables; and also for the diffusion through the soil of that genial moisture, by which the hardest clod is penetrated, softened, and fertilized.

FIG. 42.



QUESTIONS FOR EXAMINATION.

What is a fluid? Which fluids are most elastic? What is the fundamental principle regulating the pressure of fluids? Explain the principle of the Bramah press. Give instances of its power. State the "*hydrostatic paradox.*" On what does the pressure of a quantity of water on any surface depend? Show how a little water may produce dreadful natural convulsions. What was the use of aqueducts? Why are they no longer necessary? What is the condition that a solid may float in a liquid? Show that it must displace its own weight of the liquid. How may the weight of a ship be found on this principle? In what position may a man float safely? Why does an unskilful person sink? How do fishes rise and sink at will? What is specific gravity? How may the specific gravity of a heavy solid be found? Who discovered this method of doing it? Relate the story. To what rule are capillary phenomena an exception? What are these phenomena, and why so called? State instances of solids which are

wetted by water—by quicksilver. Which are not wetted by water? by quicksilver? How are capillary phenomena effected by this distinction? Give examples of capillary attraction in nature.

THE SAXON AND THE GAEL.

[THE COMBAT.]

THE Chief in silence strode before,
And reached that torrent's sounding shore,
Which, daughter of three mighty lakes,
From Vennachar in silver breaks,
Sweeps through the plain, and ceaseless mines
On Bochastle the mouldering lines,
Where Rome, the Empress of the World,
Of yore her eagle-wings unfurled.
And here his course the Chieftain staid,
Threw down his target and his plaid,
And to the Lowland warrior said:—
"Bold Saxon! to his promise just,
Vich-Alpine has discharged his trust,
This murderous chief, this ruthless man,
This head of a rebellious clan,
Hath led thee safe, through watch and ward,
Far past Clan-Alpine's outmost guard.
Now man to man, and steel to steel,
A Chieftain's vengeance thou shalt feel.
See, here, all vantageless I stand,
Armed, like thyself, with single brand:
For this is Coilantogle ford,
And thou must keep thee with thy sword."

The Saxon paused:—"I ne'er delayed,
When foeman bade me draw my blade;
Nay more, brave Chief, I vowed thy death:
Yet sure thy fair and generous faith,
And my deep debt for life preserved,
A better meed have well deserved:

Can nought but blood our feud atone?
Are there no means?"—"No, stranger, none!
And here—to fire thy flagging zeal—
The Saxon cause rests on thy steel;
For thus spoke Fate by prophet bred
Between the living and the dead;
'Who spills the foremost foeman's life,
His party conquers in the strife.'"
"Then, by my word," the Saxon said,
"The riddle is already read.
Seek yonder brake beneath the cliff—
There lies Red Murdoch, stark and stiff.
Thus Fate has solved her prophecy,
Then yield to Fate, and not to me.
To James, at Stirling, let us go,
When, if thou wilt be still his foe,
Or if the King shall not agree
To grant thee grace and favour free,
I plight mine honour, oath, and word,
That, to thy native strengths restored,
With each advantage shalt thou stand,
That aids thee now to guard thy land."

Dark lightning flashed from Roderick's eye—
"Soars thy presumption then so high,
Because a wretched kern ye slew,
Homage to name to Roderick Dhu?
He yields not, he, to man nor Fate!
Thou add'st but fuel to my hate:—
My clansman's blood demands revenge.
Not yet prepared for fight?—I change
My thought, and hold thy valour light
As that of some vain carpet-knight,
Who ill deserves my courteous care,
And whose best boast is but to wear
A braid of his fair lady's hair."
—"I thank thee, Roderick, for the word!
It nerves my heart, and steels my sword;

For I have sworn this braid to stain
In the best blood that warms thy vein.
Now, truce, farewell! and, ruth, begone!
Yet think not that by thee alone,
Proud Chief! can courtesy be shown;
Though not from copse, or heath, or cairn,
Start at my whistle clansmen stern,
Of this small horn one feeble blast
Would fearful odds against thee cast.
But fear not—doubt not—which thou wilt—
We try this quarrel hilt to hilt."

Then each at once his falchion drew,
Each on the ground his scabbard threw,
Each looked to sun, and stream, and plain,
As what they ne'er might see again;
Then foot, and point, and eye opposed,
In dubious strife they darkly closed.
Ill fared it then with Roderick Dhu,
That on the field his targe he threw,
Whose brazen studs and tough bull-hide
Had death so often dashed aside;
For, trained abroad his arms to wield,
Fitz-James's blade was sword and shield.
He practised every pass and ward,
To thrust, to strike, to feint, to guard;
While less expert, though stronger far,
The Gael maintained unequal war.
Three times in closing strife they stood,
And thrice the Saxon blade drank blood;
No stinted draught, no scanty tide,
The gushing flood the tartans dyed.
Fierce Roderick felt the fatal drain,
And showered his blows like wintry rain;
And, as firm rock, or castle roof,
Against the winter shower is proof,
The foe, invulnerable still,
Foiled his wild rage by steady skill;

Till, at advantage ta'en, his brand
Forced Roderick's weapon from his hand,
And, backward borne upon the lea,
Brought the proud Chieftain to his knee.
"Now, yield thee, or"—the Saxon said,
"Thy heart's blood, Chieftain, dyes my blade!"—
"Thy threats thy mercy, I defy!
Let recreant yield, who fears to die."
—Like adder darting from his coil,
Like wolf that dashes through the toil,
Like mountain-cat who guards her young,
Full at Fitz-James's throat he sprung;
Received, but recked not of a wound,
And locked his arms his foeman round.
Now, gallant Saxon, hold thine own!
No maiden's hand is round thee thrown!
That desperate grasp thy frame might feel,
Through bars of brass and triple steel!
They tug, they strain! down, down they go,
The Gael above, Fitz-James below.
The Chieftain's gripe his throat compressed;
His knee was planted in his breast;
His clotted locks he backward threw,
Across his brow his hand he drew,
From blood and mist to clear his sight,
Then gleamed aloft his dagger bright!
—But hate and fury ill supplied
The stream of life's exhausted tide;
And all too late the advantage came,
To turn the odds of deadly game;
For, while the dagger gleamed on high,
Reeled soul and sense, reeled brain and eye.
Down came the blow! but in the heath
The erring blade found bloodless sheath.
The struggling foe may now unclasp
The fainting Chief's relaxing grasp;
Unwounded from the dreadful close,
But breathless all, Fitz-James arose.

SCOTT.

THE ELDER'S DEATH-BED.

[JOHN WILSON, a distinguished poet, critic, and prose-writer, the well-known Christopher North of "Blackwood's Magazine," was born in Paisley in 1788, and died in 1854. He was long Professor of moral philosophy in the University of Edinburgh. He has been ranked among the "Lake Poets." His poetical writings are characterised by great beauty of description, exquisite tenderness and elegance of sentiment, and varied richness of expression. But it is chiefly in periodical literature that he earned his well-merited fame. His contributions to "Blackwood's Magazine" are marked by an extraordinary combination of the most opposite quality—pathos the purest, the deepest, and the most tender; wild, wanton, and withering sarcasm; sentiment, refined and exalted to the pitch of devotion; and humour of the freest, broadest, and most exuberant vein.]

FOR six years' Sabbaths I had seen the elder in his accustomed place beneath the pulpit, and, with a sort of solemn fear, had looked on his steadfast countenance during sermon, psalm, and prayer. On returning to the scenes of my infancy, I met the pastor going to call upon the elder; and with the privilege which nature gives us to behold, even in their last extremity, the loving and beloved, I turned to accompany him to the house of sorrow, of resignation, and of death.

And now, for the first time, I observed, walking close to the feet of his horse, a little boy about ten years of age, who kept frequently looking up in the pastor's face, with his blue eyes bathed in tears. A changeful expression of grief, hope, and despair, made almost pale, cheeks which, otherwise, were blooming in health and beauty; and I recognised in the small features and smooth forehead of childhood, a resemblance to the aged man who, we understood, was now lying on his death-bed. "They had to send his grandson for me through the snow, mere child as he is," said the minister, looking tenderly on the boy; "but love makes the young heart bold, and there is One who tempers the wind to the shorn lamb."

As we slowly approached the cottage, through a deep snow-drift, which the distress within had prevented the inmates from removing, we saw, peeping out from the door, brothers and sisters of our little guide, who quickly disappeared; and then their mother showed herself in their stead,

expressing, by her raised eyes, and arms folded across her breast, how thankful she was to see at last the pastor beloved in joy, and trusted in trouble.

A few words sufficed to say who was the stranger; and the dying man, blessing me by name, held out to me his cold, shrivelled hand, in token of recognition. I took my seat at a small distance from the bed-side, and left a closer station for those who were more dear. The pastor sat down near his elder's head; and by the bed, leaning on it with gentle hands, stood that matron, his daughter-in-law—a figure that would have sainted a higher dwelling, and whose native beauty was now more touching in its grief.

"If the storm do not abate," said the sick man, after a pause, "it will be hard for my friends to carry me over the drifts to the kirk-yard." This sudden allusion to the grave, struck, as with a bar of ice, the heart of the loving boy; and with a long, deep sigh, he fell down, with his face like ashes, on the bed; while the old man's palsied right hand had just strength enough to lay itself upon his head.

"God has been gracious to me, a sinner," said the dying man. "During thirty years that I have been an elder in your kirk, never have I missed sitting there one Sabbath. When the mother of my children was taken from me—it was on a Tuesday she died, and on Saturday she was buried—we stood together. On the Sabbath after my Alice was let down into the narrow house made for all living, I joined in the public worship of God. She commanded me to do so the night before she went away. I could not join in the psalm that Sabbath, for her voice was not in the throng. Her grave was covered up, and grass and flowers grew there."

The old man then addressed himself to his grand-child: "Jamie, thy own father has forgotten thee in thy infancy, and me in my old age; but Jamie, forget not thou thy father, nor thy mother; for that, thou knowest and feelest, is the commandment of God."

The broken-hearted boy could give no reply. He had gradually stolen closer and closer unto the loving old man,

and now was lying, worn out with sorrow, drenched and dissolved in tears, in his grandfather's bosom. His mother had sunk down on her knees, and hid her face with her hand. "Oh, if my husband knew but of this, he would never, never desert his dying father!" And I now knew that the elder was praying, on his death-bed, for a disobedient and wicked son.

At this affecting time, the minister took the family Bible on his knees, and said, "Let us sing, to the praise and glory of God, part of the fifteenth Psalm;" and he read, with a tremulous and broken voice, those beautiful verses—

"Within Thy tabernacle, Lord,
Who shall abide with thee?
And in thy high and holy hill
Who shall a dweller be?

"The man that walketh uprightly,
And worketh righteousness,
And as he thinketh in his heart,
So doth he truth express."

Ere the psalm was yet over, the door was opened, and a tall, fine-looking man entered, but with a lowering and dark countenance, seemingly in sorrow, in misery, and remorse. Agitated, confounded, and awe-struck by the melancholy and dirge-like music, he sat down on a chair, and looked with a ghastly face towards his father's death-bed. When the psalm ceased, the elder said, with a solemn voice, "My son, thou art come in time to receive thy father's blessing. May the remembrance of what will happen in this room, before the morning again shine over the Hazel-glen, win thee from the error of thy ways? Thou art here to witness the mercy of thy God, and thy Saviour, whom thou hast forgotten."

The young man, with much effort, advanced to the bedside, and at last found voice to say, "Father, I am not without the affections of nature, and I hurried home the moment I heard that the minister had been seen riding towards our house. I hope that you will yet recover; and, if

I have ever made you unhappy, I ask your forgiveness; for, though I may not think as you do on matters of religion, I have a human heart. Father, I may have been unkind, but I am not cruel. I ask your forgiveness."

"Come near to me, William; kneel down by the bed-side, and let my hand feel the head of my beloved son, for blindness is coming fast upon me. Thou wert my first-born, and thou art my only living son. All thy brothers and sisters are lying in the church-yard, beside her whose sweet face, thine own, William, did once so much resemble. Long wert thou the joy, the pride of my soul—ay, too much the pride; for there was not in all the parish such a man, such a son as my own William. If thy heart has since been changed, God may inspire it again with right thoughts. I have sorely wept for thee—ay, William, when there was none near me—even as David wept for Absalom—for thee, my son! my son!"

A long deep groan was the only reply; but the whole body of the kneeling man was convulsed, and it was easy to see his contrition, his remorse, and his despair. The pastor said, with a sterner voice and austerer countenance than were natural to him, "Know you whose hand is now lying on your rebellious head? But what signifies the word *father* to him who has denied God, the Father of us all?" "Oh, press him not too hardly!" said his weeping wife, coming forward from a dark corner of the room, where she had tried to conceal herself in grief, fear, and shame. "Spare, oh, spare my husband!—he has ever been kind to me;" and with that she knelt down beside him, with her long, soft, white arms mournfully and affectionately laid across his neck. "Go thou, likewise, my sweet little Jamie," said the elder, "go, even out of my bosom, and kneel down beside thy father and thy mother; so that I may bless you all at once, and with one yearning prayer." The child did as the solemn voice commanded, and knelt down, somewhat timidly, by his father's side; nor did the unhappy man decline encircling with his arm the child, too much neglected, but still dear to him as his own blood, in spite of the deadening and debasing influence of infidelity.

"Put the word of God into the hands of my son, and let him read aloud to his dying father the 25th, 26th, and 27th verses of the 11th chapter of the Gospel according to St. John." The pastor went up to the kneelers, and with a voice of pity, condolence, and pardon, said, "There was a time when none, William, could read the Scriptures better than couldst thou. Can it be that the son of my friend hath forgotten the lessons of his youth?" He had not forgotten them—there was no need for the repentant sinner to lift up his eyes from the bed-side. The sacred stream of the gospel had worn a channel in his heart, and the waters were again flowing. With a choked voice he read, "Jesus said unto her, I am the resurrection and the life; and whosoever liveth, and believeth in me, shall never die. Believest thou this? She saith unto him, Yea, Lord: I believe that thou art the Christ, the Son of God, which should come into the world."

"That is not an unbeliever's voice," said the dying man triumphantly; "nor, William, hast thou an unbeliever's heart. Say that thou believest in what thou hast read, and thy father will die happy!" "I do believe, and as thou forgivest me, so may I be forgiven by my Father who is in heaven." The elder seemed like a man suddenly inspired with a new life. His faded eyes kindled, his pale cheeks glowed, his palsied hands seemed to wax strong, and his voice was clear as that of manhood in its prime. "Into thy hands, O God, I commit my spirit"—and so saying, he gently sunk back on his pillow;—I thought I heard a sigh. There was then a long, deep silence; and the father, the mother, and the child, rose from their knees. The eyes of us all were turned towards the white, placid face of the figure, now stretched in everlasting rest; and without lamentations, save the silent lamentations of the resigned soul, we stood around the death-bed of the elder.

JOHN WILSON.

CATO ON THE IMMORTALITY OF THE SOUL.

It mùst be so—Pláto, thou réason'st wèll!
E'lse, whence this pleasing hòpe, this fond desíre,
This lònging after immortality?
Or, whence this secret drèad, and inward hórror,
Of falling into nòught? Why shrinks the sóul
Bàck on herself, and stàrtles at destruction?
'Tis the Divínity' that stirs withìn us:
'Tis Heaven itsèlf, that points out—an hereáfter,
And íntimates—Etèrnity to man.
Etérnity! thou pléasing, drèadful thought!
Through what varìety' of untried béing,
Through what nèw scenes and chánges' must we pàss!
The wíde, the unboùnded prospect lies befóre me,
But shàdows, cloùds, and dárkness, rèst upon it.
Hère will I hold. `If there's a Power abóve us
(And that there ís, all Nàture cries aloud
Through all her wórks), He must delíght' in vìrtue;
And that which hé delights in, múst be hàppy.
But whén? or whère? Thís world—was made for Caèsar.
I'm weary of conjéctures—thìs must end them.

[*Laying his hand on his sword.*

Thús' I am doùbly armed. My déath and life,
My bàne and ántidote, are bóth befòre me.
Thìs—in a mòment, brings me to an énd;
But thís—infórms me' I shall nèver die.
The sòul, secured in her exístence, smìles
At the drawn dágger, and defìes its point.
The stárs shall fade away, the sun hìmself
Grow dim with áge, and náture sink in yèars;
But thoú' shalt flourish in immortal yoúth,
Unhùrt' amidst the war of élements,
The wréck of matter, and the crásh of wòrlds!

ADDISON.

THE MECHANICAL PROPERTIES OF GASES.

Barometer, (*baros*, *metron*, G.) an instrument for measuring the weight of the air.
Exhausted, (*ex*, *haurio*, L.) *Lit.* drawn out.
Suction, (*sugo*, L.) *Lit.* the act of sucking.
Valve, (*valvæ*, L.)
Volume, *volvo*, *volumen*, L.) bulk; the space which any body occupies.

GASEOUS BODIES—AIR.

The best example of a gaseous substance, as well as the most common, is atmospheric air. There are others of great importance, such as oxygen, hydrogen, carbonic acid, and watery vapour or steam; but, so far as their mechanical properties are concerned, air may be taken as the type and representative of them all. It will therefore be proper, in explaining the properties of gases, to speak of air alone.

Now, since air is material, it must have all the essential properties of matter, such as *impenetrability* and *inertia.* For the same reason it must also be acted on by gravity, or, in other words, it must have *weight.* Being a fluid, it possesses the property, common to all fluids,* of *transmitting pressure equally in every direction.* And, in addition to these, it has its own peculiar properties of *compressibility* and *elasticity*, by which it is distinguished from both solids and liquids. It is true that, strictly speaking, neither solids nor liquids are entirely destitute of these last mentioned qualities; but air and the other gases exhibit them in a much higher degree, and even in a somewhat different sense.

That air is *impenetrable* was shown in a former lesson (page 219). A vessel plunged into water with its mouth downwards, does not become entirely filled with water, for the air confined in it, however much it may be compressed, must still occupy space, and exclude the water from that space. The same property may be illustrated in various other ways. One example is familiar to every boy. If a paper bag be inflated by blowing into it, and its mouth held tight, a forcible attempt to crush the sides together will cause it to burst with a loud report. A pair of bellows would burst in the same manner, if, after it has been filled

* See page 302.

with air, the nosle and valve were closed, and the boards strongly pressed together. These two last examples illustrate both the impenetrability of air, and its power of transmitting pressure in different directions.

The *inertia* of air was also referred to in a former lesson (page 222) as opposing and retarding the motion of every moving body near the earth's surface. In this resistance we have abundant proof that air, when at rest, needs force to make it move. Nor is it less certain that force is also required to stop it when in motion. In order to be satisfied of this, we have only to think of the windmill driven by the force of the wind, of the ship sailing before the breeze, of the tree bending in the storm, or of the waves lashed into fury by the tempest. Wind, let it be borne in mind, is only air in motion.

It is a more startling assertion, but not the less true, that air, like other kinds of matter, has a certain *weight*. This can be proved in various ways. Why, for instance, does a balloon rise in the atmosphere? It could not do so, unless it were lighter than its own bulk of the air in which it floats. This was already explained in the case of liquids, and in gases the principle is exactly the same. The balloon ascends, just as a cork would ascend if plunged below the surface of the water, because it displaces a mass of the fluid heavier than itself. Thus we see that air has an appreciable weight. But the same thing can be shown more directly by actually weighing it. For this purpose we require a large glass or copper flask, with a narrow neck, which must be provided with an air-tight stop-cock. By means of an air-pump, such a flask can be emptied of nearly all the air which it contains. When this has been done, let the stop-cock be turned so as to shut out the external air, and let the flask be weighed. Taking care that the weights exactly counterpoise it, let the air be re-admitted by again turning the stop-cock. Immediately the flask will be seen to become heavier, the difference being the weight of the air which has rushed into it from the surrounding atmosphere. Seeing, then, that air undoubtedly has weight, it

becomes an interesting question, what is the weight of the atmosphere itself in which we are placed. We live, as it were, at the bottom of a great ocean of air, and though that air is light compared with solid or liquid substances, yet its quantity is so great, that the weight of the whole must be enormous. We shall soon find, too, that its pressure on solids immersed in it depends on its weight. We are not without the means of calculating both, but the subject is so important, that it must be taken up in a separate lesson.

Air possesses most of the properties of liquids, except in so far as they are modified by its elasticity. When, for example, a solid is surrounded by air, as we ourselves and all other bodies near the earth's surface are, it is buoyed up by a force equal to the weight of a mass of air of the same bulk as the solid itself. Hence it weighs less than it would do in a vacuum. In most cases, this loss of weight is so insignificant, compared with the weight of the solid, that it may be disregarded. But it is a curious fact, that a pound of cork, or wool, or feathers, weighed in air in the usual way, is actually heavier than a pound of lead. It would be seen to be so, if they were weighed against each other in a vacuum. But when they are immersed in air, the bulkier body displaces more of the fluid, and therefore loses more weight, so that they exactly balance each other.

Compressibility and *elasticity* are the distinguishing characteristics of gaseous bodies. The particles of these bodies are not only destitute of all cohesion, but seem to be endowed with a mutual repulsion. Hence, if a little air be inclosed in a cylinder by an air-tight piston moving up and down above it, however far the piston may be raised, the air will spread itself through the whole space which is thus offered to it. Nor is there any known limit to its expansion. It is to this property, in virtue of which air fills all the space to which it has access, that we give the name of elasticity. Liquids and solids are said to be elastic, if, after being compressed or dilated by any force, they return to their natural dimensions on the force being removed; but the elasticity of air is always expansive, and always acting in opposition

to some external compressing force. The bulk of any quantity of air depends entirely on the force with which it is compressed. Relieve it of pressure, and it will expand almost without limit; apply sufficient force, and it may be compressed into the smallest space. And the more it is compressed, the greater will be its elasticity, or tendency to expand. If, for example, the compressing force be doubled, the elasticity will be doubled too, while the bulk of the compressed air will be reduced to one-half. Hence we have the two following general laws, which are of vast importance both in nature and art:—(1) *The elasticity of air is equal to the force which compresses it,* and (2) *the bulk or volume of any quantity of air is inversely proportional to either of these equals.*

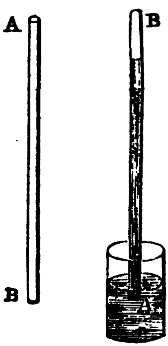
WEIGHT AND PRESSURE OF THE ATMOSPHERE—THE BAROMETER.

WE have seen that air has always a tendency to expand, and fill every part of space to which it has access. Why then, it may be asked, does the atmosphere remain in its position, swathed round the surface of our globe? Why does it not diffuse itself through the boundless regions of surrounding space? The answer is one which every careful reader should be able to find for himself. It is simply because the atmosphere is subject to the earth's attraction, or, to adopt the usual expression, it is retained in its place by *gravity.* Gravity is therefore the cause of atmospheric pressure. But here is an important difference to be noticed between the pressures at different heights in this vast aerial ocean. Every particle of air it contains is not only urged downwards by its own weight, but sustains also the weight of all the particles above it. Hence the lowest strata are the most compressed, and therefore also the densest and the most elastic. As we ascend, the pressure and elasticity gradually diminish, and, since a given quantity spreads through a larger and larger space, the density also decreases in the same proportion.

Whatever pressure a particle of air sustains, it transmits undiminished to any solid or liquid surface with which it is in contact. Nor does it matter whether that surface be horizontal, slanting, or vertical; for we know that air, like other fluids, presses equally in all directions. Would it not, then, be interesting to know with what force air at the earth's surface presses upon our bodies? We do not, indeed, feel any pressure at all, yet it is obvious from what has been already explained that such a pressure must exist. A few simple considerations will enable us to ascertain its amount.

Suppose we take a glass tube A B, open at the end A, and closed at the end B. Its length must exceed 30 inches. This tube having been filled to the brim with quicksilver, the finger is placed on the open end to prevent spilling, and the tube is then inverted. The open end is now dipped into a basin of quicksilver, and the finger withdrawn. Immediately the quicksilver begins to sink in the tube, and we might be apt to suppose that it would continue to sink till it attained the same level in the tube as in the basin outside. But it does not. It rests in equilibrium when about 28 or 30 inches higher than the level of the quicksilver in the basin. In the accompanying figure, the dark portion represents the quicksilver. Now, the question which naturally presents itself is this, Why does the quicksilver in the tube sink so far, and no farther? What force balances the weight of this column, nearly 30 inches high, of so heavy a liquid, when, according to the principles of hydrostatics, the surface of the liquid ought to be everywhere at the same level? It will easily be seen that above the mercury in the tube *there is no air*. It is impossible for air to gain access, so that the white space in the figure is necessarily a *vacuum*. But the surface of the mercury in the basin is in contact with the atmosphere, and

FIG. 43.



thus sustains a pressure equal to the weight of the air above it. That pressure, then, balances the pressure of nearly 30 inches of mercury. In other words, the pressure of the air on a *horizontal* surface (which in that case is just the weight of all the air directly above it) is equal to the weight of a mass of mercury which would cover that surface to the depth of about 30 inches. And, as already explained, the pressure on a surface not horizontal is exactly the same. Suppose, now, that we wish to know the pressure of the atmosphere on a square inch of any surface. We have simply to find the weight of a column of mercury whose base is a square inch, and height 30 inches. Such a column, it is found, weighs nearly 15 lbs. avoirdupois. The astonishing result is that the atmosphere exerts a pressure of no less than about 15 lbs. on every square inch of our bodies. The surface of a man's body measures nearly 2000 square inches, so that the total pressure which he sustains from the air around him is about 30,000 lbs., or upwards of 13 tons!

Strange as it may appear, we are not in the least incommoded by this enormous load. We do not even feel it. The reason is, that the air presses upwards, downwards, and sideways with the same force, so that the different pressures are in equilibrium. Nor do our bodies stand in any danger of being crushed by this pressure on every side. For the liquids by which they are everywhere permeated are subject to the same pressure, and transmit it equally in every direction. Thus the pressure outwards is equal to and balances the pressure inwards, so that here too there is equilibrium. It is easy to show that the liquids in the body, such as the blood, do press outwards in this manner. Let the hand, for example, be placed firmly on the mouth of a vessel communicating with an air-pump. As the air is withdrawn from the vessel, and part of the skin is thus relieved from the external pressure, the blood-vessels will become distended, and may even be ruptured by the pressure from within.

The tube of quicksilver described in this lesson is nothing else than a *barometer* in its simplest form. The weight of

the air, and the pressure depending on that weight, are different in different places, nor do they always continue the same even at the same place. To show their variations is the primary object of the barometer. Barometers are constructed in a great variety of forms, but the principle is the same in all. There is always one part of the liquid surface free from the pressure of the atmosphere, and another part exposed to it; and the difference of level gives the amount of that pressure in inches of mercury. The great weight of this liquid renders it specially suitable for barometric purposes. If water were used, it would require a tube more than 34 feet long.

Since the state of the weather depends, in a great measure, upon the atmospheric pressure, the barometer is indirectly of use as a weather-glass. The words "Fair, Rain," and so on, which we often see printed on these instruments, cannot be safely depended on, but in general, a rising of the barometer gives promise of fine weather, and a falling is indicative of wind or rain. The value of such an instrument to the farmer may easily be conceived; but it is by the mariner that it is specially prized, as it forewarns him of the coming storm, and enables him to prepare in time for the fury of the hurricane. It requires some experience, however, to interpret its prognostications with accuracy.

Another curious application of the barometer is its use in measuring the heights of mountains. It was already explained that the pressure of the atmosphere diminishes as we ascend. We leave, in fact, a part of it beneath us. Hence the mercury in the barometer stands lower and lower as we ascend. On the top of Mont Blanc, for instance, it sinks to 16 inches. Thus we are able, from the height of the barometric column at any elevated spot, to form at once a rough estimate of the elevation; and, if we have skill enough to make due allowance for temperature, and other circumstances which affect the result, a surprising degree of accuracy may in this way be attained.

THE AIR-PUMP.

We live at the bottom of a great ocean of air. Every place to which we can go is filled with it; we are surrounded by it on every side; it even finds its way into our bodies, and is essential to the continuance of our very lives. Hence the effects of its pressure are so constant and universal, that our attention is little attracted by them. But, let the air be removed from any space, and we shall soon see to how great an extent the various phenomena around us are dependent on its influence.

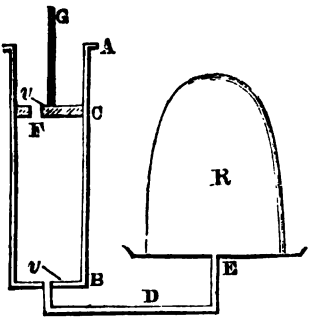
The air contained in a vessel may be almost entirely withdrawn from it by means of an *air-pump,* one of the most interesting and instructive of scientific instruments. It consists, as do also water-pumps, of a suitable combination of cylinders and air-tight pistons with certain contrivances called *valves.* The object of a valve is to prevent any fluid from passing through a tube or aperture in one direction, without interrupting its progress when flowing in the opposite direction. It is like a door which opens inwards, but not outwards; or, which opens outwards, but not inwards. Its simplest form is the *clack-valve,* which resembles in its motion the lid of a box. It plays upon a hinge, as at A, and being a little larger than the aperture which it covers, it effectually stops any fluid flowing downwards. For it is evident that the greater the pressure of the fluid, the more firmly will the valve be shut. On the other hand, a fluid pressing upwards opens the valve by its pressure, and thus makes a passage for itself.

Fig. 44.

Suppose now that we have a hollow cylinder A B with an air-tight piston working in it, as at C. Into an aperture in the bottom of the cylinder is inserted a bent tube D, the mouth of which is closed by a valve v opening upwards, to prevent air from passing out of the cylinder into the tube. The other end of the tube is fitted into an opening in the centre of a flat plate of metal E, on which is placed, mouth downwards, a glass vessel R, called the *receiver.* It is from

this vessel that the air is to be extracted, and the name of receiver is given to it, because it *receives*, or holds the objects on which experiments are to be made. That it may lie air-tight on the plate, its edge is ground very smooth, and it must also, from time to time, be rubbed over with grease. The only essential part of the machine, which has not been already mentioned, is an aperture at F in the piston itself, also closed by a valve opening upwards, to exclude the surrounding atmosphere.

Fig. 45.



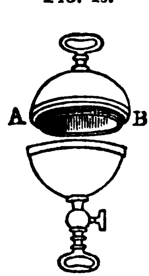
We shall suppose that the piston is at the bottom of the cylinder. When it is drawn up, by means of its rod G, a vacuum is left in the cylinder, which cannot be filled by air from without, for the valve at F is shut. The pressure of the air in the tube, being no longer balanced by a corresponding pressure in the cylinder, will open the lower valve, and the whole of the air in the tube and receiver will diffuse itself equally, in virtue of its elasticity, throughout the receiver, the tube, and the part of the cylinder below the piston. Its volume being thus increased, its elasticity will be proportionably diminished, and therefore it will not be able to open the upper valve, which is kept shut by the atmospheric pressure without. But as soon as the piston begins to descend again, the air in the cylinder is compressed, and by its pressure towards the receiver the lower valve is immediately shut. The air in the cylinder, thus cut off from communication with the receiver, gains elasticity as the piston descends, until at last its pressure exceeds that of the atmosphere. It then forces up the upper valve, and, as the piston continues to descend, gradually escapes through the opening at F. The piston, having reached the bottom of the cylinder, is again drawn up, and the whole process is

repeated. At every upward stroke, part of the air in the receiver passes into the cylinder, and the valve placed between them prevents its return. At the downward stroke, it is discharged into the atmosphere. The receiver is thus gradually emptied, till the air that remains in it has too little elasticity to lift the valves. It is then said to be *exhausted.*

It must not be understood that this is the only form of the air-pump. It is not even the usual form. For, generally speaking, it is found convenient to have two cylinders, with a branch of the tube D opening into each. They are so connected that, while the one piston ascends, the other descends. The piston rods are provided with teeth, into which is fitted a toothed wheel worked by a winch. The exhaustion is thus completed in one-half the time that would be required with one cylinder; for each cylinder acts separately, as if there were but one. Sometimes, too, the receiver is of a different form. It may, for example, be a vessel with a small neck, which could not conveniently stand inverted on the plate. In this case, the mouth of the receiver must be screwed into the mouth of the tube at E.

Many interesting experiments, illustrating the elasticity and pressure of air, may be made by means of an air-pump. The following is one of the most astonishing. Two hollow hemispheres of equal size, furnished with handles, are placed with their edges in contact, the junction being made air-tight by rubbing one of the edges, as A B, with grease. One of the handles can be taken off, being screwed upon a narrow neck provided with a stop-cock. Through this neck the air inside the hemispheres is extracted, and, the stop-cock being shut, the apparatus is then detached from the air-pump, and the handle again screwed on. If the hemispheres be a few inches in diameter, two boys will be unable to pull them asunder. Yet no sooner is the air re-admitted, than they will fall asunder by their own weight. This experiment was first tried at

FIG. 45.



Magdeburg, more than 200 years ago, and hence the apparatus is called the Magdeburg hemispheres.

A bladder half filled with air, if placed beneath the receiver of an air-pump, will gradually swell as the exhaustion proceeds, and at last will burst with a loud report. A thin square phial, firmly corked, will be shivered to pieces in like manner. In the same situation, shrivelled fruit becomes plump, the flame of a candle goes out, a bell ceases to give forth any sound, and water boils almost before it is warm. Some have tried how a living animal would be affected by exhausting the air around it. The experiment is a cruel one, and one which no good boy would like to look at. A mouse, for example, placed beneath a receiver, suffers the greatest agony as the air becomes less and less dense, till at last the violent rupture of some of its blood vessels puts an end to its distress. There can be no doubt that the experimenter himself, if placed beside it, would share the same fate.

WATER-PUMPS.

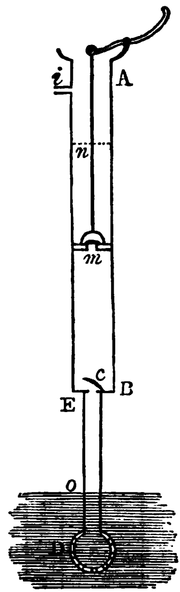
It seems impossible that water should flow upwards, and we naturally think that it never does so of its own accord. So far we think rightly. But neither is it of its own accord that it flows downwards; for it has no power of motion in itself, and, were there no force acting upon it, it could not move either the one way or the other. Gravity causes it in general to seek a lower level; but, on the other hand, there is no reason why, if impelled by any adequate force, it should not as readily ascend to a higher. We saw in a former lesson* that it rises in a close tube laid across a valley to the same level at which it enters the tube. In a common *suction-pump*, it is raised by the pressure of the atmosphere.

The suction-pump consists of a cylinder A B, similar in all respects to that of the air-pump; the tube or pipe B D

* Page 304.

is wider than the tube of the air-pump, and instead of communicating with a receiver, goes down into the well or reservoir containing the water to be raised. Into this pipe the water is admitted at D through a number of small holes, so as to exclude any floating solids which might tend to choke up the pipe. Before the action of the pump commences, the water inside and outside the pipe will stand at the same level O. The piston is usually worked by a lever attached to its rod, and supported on a fulcrum above A. On raising the piston, the air in the pipe and lower part of the cylinder becomes rarefied, exactly as in the air-pump. Its pressure on the surface of the water in the pipe is thus diminished, and is no longer sufficient to balance the pressure of the atmosphere on the surface of the water outside. The water accordingly rises in the tube to restore equilibrium, on the same principle which causes the mercury in the tube of a barometer to stand higher than the mercury in the basin. As the exhaustion goes on, the water rises through the valve *c* into the cylinder, the lower part of which soon becomes filled. When the piston again descends, this water being prevented by the valve *c* from returning into the pipe, forces up the valve at *m*, and part of it escapes into the space *above* the piston. The piston, in its next ascent, carries this portion upwards along with it, and the vacuum thus left below is filled by a fresh supply from the pipe. This process goes on till the water above the piston reaches the spout *i*. Whenever any portion of the water rises above either *valve*, it is clear that it cannot return, because both the valves open upwards.

FIG. 47.

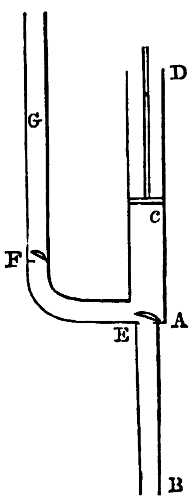


The pressure of the atmosphere being equal, at the level of the sea, to the weight of a column of water about 34 feet

high, the surface of the water under the piston can never, in any case, be more than 34 feet above the surface of the water in the well or reservoir below. In practice, however, we cannot procure a perfect vacuum, and therefore it is better that the line *n*, the upper limit of the piston's motion, should not be more than 28 feet above O. It was an unsuccessful attempt to raise water in this way to a greater height than the atmospheric pressure will balance, that led to the discovery of the real cause of what we still commonly call *suction*. For suction is nothing else than the effect of producing a vacuum, or rarefaction of the air in any space, into which the pressure of the atmosphere immediately forces any fluid which has access to it. Thus we suck up water through a straw, and thus the infant draws milk from its mother's breast.

The *forcing*-pump enables us to raise water to any height.

Fig. 48.



Its piston *c* differs from that of the suction-pump in having no valve or aperture. Instead of this, there is a bent tube GE, communicating with the lower part of the cylinder, and provided with a valve at F, which opens upwards. The water rises through the tube BA into the cylinder, on the same principle as in the suction-pump. When the piston descends, it presses on the water in the cylinder, which, since the valve at A is closed against it, must force its way through the valve F. As soon as the pressure of the piston is removed, the valve F shuts, and prevents the return of any part of the water which has passed it. Meanwhile the piston is again drawn up, leaving a vacuum, which is filled by a fresh supply from the pipe. This in its turn is forced upwards through the valve F, and by continuing the process the water may be made to rise in the tube G to any required height.

One of the most useful applications of this instrument is the fire-engine, by which so much valuable property has been saved. It is a combination of two forcing-pumps, throwing water copiously into a close vessel partly filled with air. The air, being much compressed, and therefore highly elastic, impels the water with great force along a flexible pipe or hose, from the mouth of which it gushes in a continuous stream upon the flames. Few better examples could be found of the benefits which mankind may derive from even a little knowledge of mechanical science.

QUESTIONS FOR EXAMINATION.

Name examples of gaseous bodies. What are the chief properties of air? Which is common to it with liquids? Which are characteristic? Give examples of its impenetrability. What is wind? What property of air does the force of the wind illustrate? How is it proved that air has weight? What effect has it on the weight of bodies surrounded by it? State the relations between the volume of a mass of air and its elasticity. How is the atmosphere prevented from spreading outwards? Where is it densest? Show how the weight of the air may be estimated? Explain the principle of the barometer. Why do we not feel the pressure of the air on our bodies? Of what value is the barometer as a weather-glass? For what other purpose is it used? What is the use of the air-pump? Explain its construction. What are valves used for? Explain the action of an air-pump with one cylinder. What is the usual form of the instrument? What are the Magdeburg hemispheres, and what do they illustrate? Why does water flow downwards? What is necessary to make it flow upwards? What force does so in the suction-pump? Explain the construction of such a pump, and show how it acts. How far can water be raised by suction? What is suction? Explain the construction of a forcing-pump, and of a fire-engine.

QUARREL OF BRUTUS AND CASSIUS.

Cas. That you have wrònged me¹ doth appear in thìs:
You have condemned and noted Lucius Pélla,
For taking bríbes here of the Sàrdians;
Wherein my lètter, pràying on his side,
Because I knéw the man, was slìghted off.
Bru. You wronged yoùrself¹ to write in such a case.
Cas. In such a time as thís¹ it is not meet
That every nìce offence should bear its cómment.

Bru. Let me tèll you, Cassius, you yoursèlf
Are much condemned to have an itching palm;
To sell and mart your offices for góld
To undesèrvers.
Cas. I′ an itching palm?
You know that you are Brùtus that speak this,
Or, by the gods, this speech were else your làst.
Bru. The name of Càssius hònours this corrúption,
And chástisement[1] doth therefore hide its hèad.
Cas. Chástisement!
Bru. Remember Màrch, the 'Ides of March remember!
Did not great Július bleed for justice' sake?
What vìllain touched his body, that did stab,
And not for jústice? Whát! shall one of ús,
That struck the foremost man of all this wòrld
But for suppórting robbers, shall wè now
Contaminate our fingers with base bríbes,
And sell the mighty space of our large hónours
For so much tràsh as may be graspèd thús?——
I had rather be a dòg, and bay the mòon,
Than such a Roman.
Cas. Brutus, bay not mè;
I'll not endùre it: you forgèt yourself,
To hedge mé in. I am a sòldier, I′,
Older in práctice, abler than yoursèlf
To make conditions.
Bru. Go tò; you arè not, Cassius.
Cas. I àm.
Bru. I say you are nòt.
Cas. Urge me no móre, I shall forgèt myself;
Have mind upon your hèalth, tempt me no fùrther.
Bru. Awày, slight man!
Cas. Is't póssible?
Bru. Hèar me, for I will speak.
Must 'I give way and room to your rash chóler?
Shall I be frighted when a mádman stares?
Cas. O ye gòds! ye gods! must I endure all thís?
Bru. All thís? ay, mòre. Frèt till your proud heárt breàk;

Gò, show your slàves how choleric you are,
And make your bòndmen tremble. Must 'I búdge?
Must 'I observe yoú? must 'I stand and crouch
Under yoúr testy humour? By the gods,
You shall digest the venom of your spléen,
Though it do split you; for, from this day forth,
I'll use you for my mìrth, yea, for my làughter,
When you are waspish.

Cas. Is it come to thís?

Bru. You say, you are a bètter soldier:
Let it appèar so; make your vaunting trúe,
And it shall please me wèll. For mine ówn part,
I shall be glad to learn of nóble mèn.

Cas. You wróng me èvery way; you wròng me, Brutus;
I said an èlder soldier, not a bétter.
Did I say bétter?

Bru. If you díd, I càre not.

Cas. When Cæsar lived, he durst not thus have moved me.

Bru. Pèace, pèace; you durst not so have tèmpted him.

Cas. I' durst not?

Bru. Nò.

Cas. Whát? durst not tempt hím?

Bru. For your lìfe you durst not.

Cas. Do not presume tòo much upon my love;
I mày do thát I shall be sòrry for.

Bru. You hàve dóne that you shoùld be sorry for.
There is no terror, Cassius, in your thréats;
For I am armed so strong in hónesty,
That they pass bý me! as the idle wìnd,
Which I respèct not. I did send to you
For certain sums of góld, which you denìed me;—
For I can raise no móney by vìle means:
By heaven, I had rather coin my heàrt,
And drop my blòod for drachmas, than to wring
From the hard hands of peasants their vile trash
By any indirèction! I did send
To you for gold to pay my légions,
Which you denìed me. Was thát done like Cassius?

Should 'I have answered Caius Cássius so?
When Marcus Brùtus grows so covetous,
To lock such ràscal counters from his friénds,
Be rèady, gods, with all your thúnderbolts,
Dàsh him to pieces!

Cas. 'I deníed you nòt.

Bru. You dìd.

Cas. I did nòt: he was but a fòol
That brought my answer back.—Brutus hath rìved my heart:
A friènd should bear his friend's infírmities,
But Brùtus makes míne greater than they àre.

Bru. I dò not, till you practise them on mè.

Cas. You lòve me not.

Bru. I do not like your fáults.

Cas. A friéndly eye could never sèe such faults.

Bru. A flàtterer's would not, though they did appear
As húge as high Olỳmpus.

Cas. Come, A'ntony, and young Octàvius, come;
Revenge yourselves alòne on Cássius,
For Cássius[1] is a-wèary of the world:
Háted by one he lòves; bráved by his bròther;
Chécked like a bòndman; all his fáults obsèrved,
Set in a nòte-book, lèarned, and conned by róte,
To cast into my tèeth. Oh, I could wéep
My spírit from mine eỳes!—Thère is my dágger,
And hére my naked brèast! withín, a heart
Dearer than Plutus' míne, richer than gòld:
If that thou béest a Roman, take ìt forth;
'I, that denied thee góld, will give my heàrt:
Strìke, as thou didst at Cæsar; for I know,
When thou didst hate hìm wórst, thou lovèdst him bétter
Than ever thou lovedst Càssius.

Bru. Sheathe your dàgger:
Be angry when you wíll, it shall have scòpe;
Dó what you will, dishonour shall be hùmour.
O Càssius, you are yokèd with a lámb
That carries ánger as the flint bears fìre;
Who, much enfórced, shows a hasty spárk,

And straight is còld again.
Cas. Hath Cassius lived
To be but mirth and làughter to his Brutus,
When grief, and blood ill-tempered, véxeth him?
Bru. When I spoke thát, I′ was ill-tempered tòo.
Cas. Do you confess so múch? give me your hànd.
Bru. And my heàrt too. [*Embracing.*
Cas. O Brútus!—
Bru. Whát's the màtter?
Cas. Have you not lòve enough to béar with me,
When that rash humour which my mòther gave me
Makes me forgétful?
Bru. Yès, Cassius; and, from henceforth,
When you are òver-earnest with your Brútus,
He'll think your mòther chides, and lèave you so.

SHAKSPEARE.

SHERIDAN'S INVECTIVE AGAINST WARREN HASTINGS.

[RICHARD BRINSLEY SHERIDAN, distinguished as a statesman, wit, and dramatist, was born at Dublin in 1751, and died in 1816. He was returned to Parliament as member for the borough of Stafford, and attained distinguished celebrity as an orator. He made the grandest display of his eloquence during the impeachment of Warren Hastings. His writings are chiefly dramatic.]

HAD a stranger, at this time, gone into the province of Oude, ignorant of what had happened| since the death of Sujah Dowla, that man, who, with a savage heart, had still great lines of character, and who, with all his ferocity in war, had still, with a cultivating hand, preserved to his country the riches| which it derived from benignant skies and a prolific soil—if this stranger, ignorant of all that had happened| in the short interval, and observing the wide and general devastation, and all the horrors of the scene—of plains| unclothed and brown—of vegetables| burnt up and extinguished—of villages| depopulated and in ruin—of temples| unroofed and perishing—of reservoirs| broken down and dry—he would naturally inquire, what war| has thus laid waste the fertile fields| of this once beautiful| and

opulent country—what civil dissensions have happened, thus to tear asunder and separate the happy societies that once possessed those villages—what disputed succession, what religious rage, has, with unholy violence, demolished those temples, and disturbed fervent, but unobtruding piety, in the exercise of its duties?

What merciless enemy has thus spread the horrors of fire and sword—what severe visitation of Providence has dried up the fountain, and taken from the face of the earth every vestige of verdure? Or, rather, what monsters have stalked over the country, tainting and poisoning, with pestiferous breath, what the voracious appetite could not devour? To such questions, what must be the answer? No wars have ravaged these lands and depopulated these villages, no civil discords have been felt—no disputed succession—no religious rage—no merciless enemy—no affliction of Providence, which, while it scourged for the moment, cut off the sources of resuscitation—no voracious and poisoning monsters—no, all this has been accomplished by the friendship, generosity, and kindness of the English nation. They have embraced us with their protecting arms, and, lo! those are the fruits of their alliance. What, then, shall we be told that, under such circumstances, the exasperated feelings of a whole people, thus goaded and spurred on to clamour and resistance, were excited by the poor and feeble influence of the Begums!

When we hear the description of the paroxysm, fever, and delirium, into which despair had thrown the natives, when on the banks of the polluted Ganges, panting for death, they tore more widely open the lips of their gaping wounds, to accelerate their dissolution; and, while their blood was issuing, presented their ghastly eyes to heaven, breathing their last and fervent prayer, that the dry earth might not be suffered to drink their blood, but that it might rise up to the throne of God, and rouse the eternal Providence to avenge the wrongs of their country. Will it be said that this was brought about by the incantations of these Begums in their secluded Zenana? or that they

could inspire this enthusiasm and this despair into the breasts of a people who felt no grievance, and had suffered no torture? What motive, then, could have such influence in their bosom? What motive? *That* which nature, the common parent, plants in the bosom of man, and which, though it may be less active in the Indian than in the Englishman, is still congenial with, and makes part of his being—*that* feeling which tells him, that man was never made to be the property of man; but that when, through pride and insolence of power, one human creature dares to tyrannize over another, it is a power usurped, and resistance is a duty—that feeling which tells him that all power is delegated for the good, not for the injury of the people, and that when it is converted from the original purpose, the compact is broken, and the right is to be resumed—that principle which tells him, that resistance to power usurped is not merely a duty which he owes to himself and to his neighbour, but a duty which he owes to his God, in asserting and maintaining the rank which he gave him in the creation! to that common God, who, where he gives the form of man, whatever may be the complexion, gives also the feelings and the rights of man—that principle, which neither the rudeness of ignorance can stifle, nor the enervation of refinement extinguish—that principle, which makes it base for a man to suffer when he ought to act, which, tending to preserve to the species the original designations of Providence, spurns at the arrogant distinctions of man, and vindicates the independent qualities of his race.

SHERIDAN.

THE ISLES OF GREECE.

THE isles of Greece, the isles of Greece!
   Where burning Sappho loved and sung,
Where grew the arts of war and peace—
   Where Delos rose, and Phœbus sprung!
Eternal summer gilds them yet,
But all, except their sun, is set.

The Scian and the Teian muse,
 The hero's harp, the lover's lute,
Have found the fame your shores refuse;
 Their place of birth alone is mute
To sounds which echo further west
Than your sires' "Islands of the Blest."

The mountains look on Marathon—
 And Marathon looks on the sea;
And musing there an hour alone,
 I dreamed that Greece might still be free;
For standing on the Persian's grave,
I could not deem myself a slave.

A king sate on the rocky brow
 Which looks o'er sea-born Salamis;
And ships, by thousands, lay below,
 And men in nations;—all were his!
He counted them at break of day—
And when the sun set where were they?

And where are they? and where art thou,
 My country? On thy voiceless shore
The heroic lay is tuneless now—
 The heroic bosom beats no more!
And must thy lyre, so long divine,
Degenerate into hands like mine?

'Tis something, in the dearth of fame,
 Though linked among a fettered race,
To feel at least a patriot's shame,
 Even as I sing, suffuse my face;
For what is left the poet here?
For Greeks a blush—for Greece a tear.

Must *we* but weep o'er days more blest?
 Must *we* but blush?—Our fathers bled.
Earth! render back from out thy breast
 A remnant of our Spartan dead!
Of the three hundred grant but three,
To make a new Thermopylæ!

What, silent still? and silent all?
  Ah! no; the voices of the dead
Sound like a distant torrent's fall,
  And answer, "Let one living head,
But one arise—we come, we come!"
'Tis but the living who are dumb.

In vain—in vain: strike other chords;
  Fill high the cup with Samian wine!
Leave battles to the Turkish hordes,
  And shed the blood of Scio's vine!
Hark! rising to the ignoble call—
How answers each bold bacchanal!

You have the Pyrrhic dance as yet,
  Where is the Pyrrhic phalanx gone?
Of two such lessons, why forget
  The nobler and the manlier one?
You have the letters Cadmus gave—
Think ye he meant them for a slave?

Fill high the bowl with Samian wine!
  We will not think of themes like these!
It made Anacreon's song divine:
  He served—but served Polycrates—
A tyrant; but our masters then
Were still, at least, our countrymen.

The tyrant of the Chersonese
  Was freedom's best and bravest friend;
That tyrant was Miltiades!
  Oh! that the present hour would lend
Another despot of the kind!
Such chains as his were sure to bind.

Fill high the bowl with Samian wine!
  On Suli's rock, and Parga's shore,
Exists the remnant of a line
  Such as the Doric mothers bore;
And there, perhaps, some seed is sown,
The Heracleidan blood might own.

Trust not for freedom to the Franks—
They have a king who buys and sells!
In native swords, and native ranks,
The only hope of courage dwells;
But Turkish force, and Latin fraud,
Would break your shield, however broad.

Fill high the bowl with Samian wine!
Our virgins dance beneath the shade—
I see their glorious black eyes shine;
But gazing on each glowing maid,
My own the burning tear-drop laves,
To think such breasts must suckle slaves.

Place me on Sunium's marbled steep,
Where nothing, save the waves and I,
May hear our mutual murmurs sweep;
There, swan-like, let me sing and die:
A land of slaves shall ne'er be mine—
Dash down yon cup of Samian wine!

BYRON.

SOUND.

Echo, (G.) a reflected sound.
Gamut, (from the Greek letter *gamma*) the musical scale.
Medium, (L.) the substance by which sound, light, heat, &c., are transmitted from one point to another. *Plural*, *mediums* or *media*.
Octave, (*octavus*, L.) an eighth, or musical interval of seven degrees, and therefore of eight notes, the first and last being counted.
Oscillate, (*oscillo*, L.) to swing, or move backwards and forwards. Hence also *oscillation*.
Pendulum, (*pendo*, L.) a vibrating body suspended from a fixed point, as in a clock.
Propagate, (*propago*, L.) to spread: when *applied to light, sound*, &c., it means to impel, or move forward in space, and at the same time to multiply by successive production. Hence *propagation*.
Scale, (*scala*, L.) *Lit.* a ladder.
Vibrate, (*vibro*, L.) to swing; to move this way and that, to oscillate. Hence *vibratory* and *vibration*.

SOUND-WAVES, AND THEIR PROPAGATION.

THERE are few things so apt to deceive us as the motion of waves. When we stand upon the sea-shore, and look beyond the line of breakers at our feet, we see wave behind wave, far as the eye can reach, all of them manifestly advancing towards us. It seems as if the sea were gradually

flowing in upon the land. If the tide is advancing, this may be so far in accordance with fact, but the appearance is quite the same even when the tide is receding. It must therefore be a deception. Take another case of wave motion, that of a field of standing corn agitated by the wind. Every one who has been in the country on a windy day in summer must have noticed how waves, not unlike those of the sea, travel visibly over such a field in the direction in which the wind blows. Yet we know that the stalks of corn are not carried out of their places. Each stalk stoops in succession as the wind passes over it, and then recovers itself, partly by its own strength, and partly by the reaction of the other stalks which it strikes. The ears meanwhile go and return with a sort of vibratory or alternate motion. Once more, look what happens when a stone is thrown into a pool. Immediately circular waves, proceeding from the stone as a centre, spread in every direction, each gradually increasing in diameter as it goes. Yet the surface does not become hollow at the point from which all the waves are moving. The fact is, that it is the waves alone which have a progressive motion, the water composing them, like the stalks and ears of corn, has only a vibratory or alternate motion. It simply moves up and down. The same thing is true of the sea itself. The waves move towards the land, the water of which they are formed does not.

In every substance which is elastic, whether solid, liquid, or gaseous, the particles may be thrown into a kind of vibratory motion, similar to the motion of waves. If any part of such a body is compressed, as when a bell is struck by its clapper, the elasticity of the compressed particles urges them to expand again, and by their expansion the force of the blow is conveyed to the surrounding parts. By these the process is repeated, and the impulse transmitted to a still wider circle. Thus the motion spreads in every direction, as the waves do in a pool into which a stone has fallen. But this is not all. The elastic force called into action by compression, does more than restore the compressed parts to their former dimensions. When a pendulum

hanging at rest is drawn to one side and let go, it does not simply return to its position of rest, and there suddenly stop. The reason is obvious. Being in motion when it arrives at that position it cannot stop of its own accord, and therefore goes towards the other side, till gravity first stops it, and then pulls it back. Thus it continues to oscillate from one side to the other. Exactly in the same way, the elasticity of a compressed substance tends to produce oscillation. Compression is succeeded by undue dilatation, to be followed again by compression, then again by dilatation, and so on. Hence the motion caused by striking an elastic body, is a vibratory motion consisting of alternate compressions and dilatations, and propagated in every direction after the manner of waves. Now here is the point which, from its importance, demands special attention. *It is this vibratory, wavy motion which gives us the sensation of* SOUND.

How the motion becomes a sensation no man can tell; it is one of the mysteries of life, known to God only. Even the structure of the ear, the mere instrument in this strange transformation, is not well understood. But this we do know, that unless some vibrating substance, or *medium*, is in contact with the ear, no sound will be heard. The most common medium of sound is atmospheric air. We have already learned that a bell struck in a vacuum gives no sound.

Waves of sound are propagated at different rates through different substances. In air, they travel faster or slower according to the temperature, but the usual rate is about 1120 feet per second, or more than 12 miles in a minute. When a gun is fired, the flash and the report are really simultaneous, and to a person standing close by they appear to be so. But a person at a distance sees the flash a considerable time before he hears the report. Light travels so very fast, that we may suppose it to pass instantaneously from the gun to the eye of the spectator, even though he be several miles away. Sound, however, goes more slowly, taking one second for every 1120 feet it has to travel. If, therefore, we reckon 1120 feet for every second after we

see the flash of a gun until we hear the report, we shall have a pretty correct estimate of the distance of the gun from us. The same principle applies to thunder and lightning. These also are really simultaneous, but we usually see the lightning first. If the thunder-cloud is far off, there is a long interval between them, because the sound takes long to reach us. But when the peal follows close upon the flash, the thunder-cloud must be near, and is therefore dangerous.

As the elasticity of air is reduced, it conveys sounds more and more feebly. Thus, on the top of a high mountain one must, as it were, try to speak louder than usual, in order to be distinctly heard. It is remarkable, however, that it is only the *intensity* of sound which is thus diminished in a rarefied medium; its *velocity* remains the same. It is also worthy of notice, that, in the same medium, sounds of all kinds are propagated with equal speed. The report of a cannon travels no faster than the soft notes of a guitar.

Though air is the most common, it is by no means the best conductor of sound. The velocity of sound-waves in water is not much less than a mile per second. In elastic solids, they travel still faster; in glass and steel, for example, upwards of three miles per second. Sounds are also heard louder when conveyed to the ear by solid media. Thus, the scratching of a pin at one end of a long piece of timber, may be heard by an ear applied near the other end, though it could not be heard at the same distance through the air. On the same principle, the American Indian stoops with his ear close to the ground, in order to catch the sound of distant footsteps. If a piece of ribbon or garter be tied round the top of a poker, and the ends pressed one on each ear by a finger, while the poker hangs freely down, a gentle knock on the lower end of the poker will be heard like the tolling of a large bell. This is an experiment which any boy may try, and which is sure to astonish him.

When a sound-wave strikes against a wall, a mountain, or any other obstacle, it is reflected, and produces what we call an *echo*. If it then meet another obstacle, it will be

reflected a second time, and this will give rise to a double echo. In certain peculiar situations, especially in mountainous countries, this process is repeated again and again, and the effect is sometimes most fantastic and surprising. The clouds themselves reflect sound, and produce indistinct echoes. It is to this that we owe the rolling of thunder, which is generally nothing more than the reverberation of a single sound, reflected from the clouds to the earth, and from the earth back again to the clouds. Hence the grandeur of a thunder-storm among mountains, where each mountain repeats the sound, till it gradually dies away. This is beautifully described by Lord Byron, as witnessed by him in the Alps:—

"Far along,
From peak to peak, the rattling crags among,
Leaps the live thunder; not from one lone cloud,
But every mountain now hath found a tongue,
And Jura answers, through her misty shroud,
Back to the joyous Alps, which call to her aloud."

MUSICAL SOUNDS.

If it be wonderful that a vibratory motion, when communicated to the ear, should give us the sensation of sound, how can we sufficiently admire the still more wonderful variety of that sensation! All sounds, as we have seen, travel through the same medium with equal velocity, but there must be some difference between the sound-waves of a whisper, a shriek, a huzza, and a peal of thunder. The nature and causes of that difference have not yet been fully ascertained. There is, however, one great and leading distinction between different sounds which admits of a simple and most remarkable explanation. Almost every one knows what is meant by a *musical sound,* and can distinguish it from a mere *noise.* If there be some who cannot, it is impossible to help them by a verbal description, for the differ-

ence cannot be expressed in words. Now one cause at least of this difference lies in the uniformity and regularity of the vibrations by which the sound is produced.

Suppose a card to be held close to the circumference of a toothed wheel which is made to revolve slowly, each tooth striking the edge of the card as it passes. The sound heard will be a sort of rattle, consisting of a series of *taps* or *beats*, all of the same loudness, and succeeding each other at equal intervals. But if the wheel be made to revolve with sufficient rapidity, the ear will no longer be able to distinguish the separate taps, and the sound will therefore be continuous. The reason is that the motion communicated to the organism of the ear by any particular tap, has not time to subside before the next impulse arrives. As the taps, however, though no longer heard separately, are still regular and equal, *the result will be a musical sound.* The same singular fact is illustrated by a little experiment which boys often perform, without thinking of the instruction to be gathered from it. Who has not tried to produce a screak by holding his slate-pencil upright between his fore-finger and thumb, and running the point of it along his slate? Well, try it again, and notice more particularly what happens. First, hold the pencil loosely, and you will find that it does not screech, but simply rattles, the point jumping along, and making a dotted line as it goes. Now, press gently, and the dots become closer, the taps succeed each other more rapidly. Increase the pressure, and the separate taps will no longer be distinguishable. The sound will be a continuous one, certainly far from agreeable, but nevertheless musical. Its intolerable harshness may perhaps be partly owing to a want of perfect regularity in the motion of the pencil. We do not know *all* the causes which make a sound pleasing or displeasing to the ear. But this at least is certain, that all vibrations, in proportion as they are regular, uniform, and equal, produce sounds proportionably more agreeable and musical.

Musical sounds differ among themselves in various respects, and to their skilful combination we owe all those

charming effects of melody and harmony which constitute *music*. Some of their differences cannot be easily explained, but one, the difference of *pitch*, has been shown to depend solely on the number of vibrations which strike the ear in a given time. It is this which determines whether a note is high or low in the musical scale. The reader is supposed to know what is meant by the pitch of a note, and to be able to distinguish between a high note and a low one. But it may be well to remind him, that a high note is not necessarily loud, pitch being altogether different from *loudness* or *intensity*. Now all notes of the same pitch, whether loud or not, are found to be produced by vibrations succeeding each other with the same rapidity. If the rate of vibration be increased, a higher note is the result.

Let us return for a little to the experiment of the card and wheel. The faster the wheel revolves, the higher will be the sound produced, and, by properly regulating the rate of revolution, we may obtain all the notes of the gamut from this simple apparatus. As the beat of each tooth against the card causes a separate vibration, and the number of such beats in a second can be easily ascertained, it is quite possible in this way to find how many vibrations per second are necessary to produce a sound of any given pitch. The result of such an inquiry need not here be given in detail. But it is interesting to know that doubling the rate of vibration makes the sound *an octave* higher, and, in general, that all the notes of the scale correspond to rates of vibration bearing a simple numerical proportion to each other. The lowest note on a large piano-forte is produced by vibrations at the rate of 27 per second, the highest by vibrations at the rate of about 3500 per second. Strings vibrate with more or less rapidity according to their length and tightness. Hence it is that the violin player, by properly tuning his instrument, and placing his fingers on the strings, so as to vary the length of the vibrating portions, can produce such a wonderful variety of sounds. For a similar reason the pipes of an organ are made of unequal length, and the length of a flute is virtually altered by opening or shutting

the holes. The shorter a pipe or string is, the more rapid are its vibrations, and the higher its note.

Most people fancy that the hum of a bee is, like the song of a bird, a vocal sound. But the fact is, that it is produced by the creature's little wings, whose constant flapping throws the surrounding air into vibration. The same thing is true of other insects. The wings of a gnat, for example, give forth a note more than two octaves higher than the highest note of a good piano-forte, from which it follows that they must flap at the rate of 15,000 times per second! What an astounding discovery—how little to be expected—how difficult fully to realize—and how well calculated to fill our minds with admiring reverence for the Great Author of nature, who has made the least, as well as the greatest of His works to show forth His praise!

QUESTIONS FOR EXAMINATION.

Give examples of wave motion. In what respect is it deceptive? Describe the nature of the motion which produces sound. At what rate does sound travel in air? in water? in glass? How may we know the distance of a thunder-cloud? Show that solids convey sound better than air. Explain the phenomena of echoes. What is necessary to the production of a musical sound? Give two examples of a musical sound produced by a rapid succession of taps. What determines the pitch of a note? How may the rate of vibration corresponding to any note be ascertained? Give examples of different rates. Why has a flute holes? Why has an organ pipes of different length?

THE FIELDS.

CONSIDER what we owe merely to the meadow-grass, to the covering of the dark ground by that glorious enamel, by the companies of those soft, and countless, and peaceful spears. The fields! Follow but forth for a little time the thoughts of all that we ought to recognise in those words. All spring and summer is in them—the walks by silent, scented paths—the rests in noonday heat—the joy of herds and flocks—the power of all shepherd life and meditation—the life of sunlight upon the world, falling in emerald streaks, and failing in soft blue shadows, where else it would have struck

upon the dark mould, or scorching dust—pastures beside the pacing brooks—soft banks and knolls of lowly hills—thymy slopes of down overlooked by the blue line of lifted sea—crisp lawns all dim with early dew, or smooth in evening warmth of barred sunshine, dinted by happy feet, and softening in their fall the sound of loving voices: all these are summed in those simple words; and these are not all. We may not measure to the full the depth of this heavenly gift in our own land; though still, as we think of it longer, the infinite of that meadow sweetness, Shakspeare's peculiar joy, would open on us more and more, yet we have it but in part. Go out, in the spring time, among the meadows that slope from the shores of the Swiss lakes to the roots of their lower mountains. There, mingled with the taller gentians and the white narcissus, the grass grows deep and free; and as you follow the winding mountain paths, beneath arching boughs all veiled and dim with blossom—paths that for ever droop and rise over the green banks and mounds sweeping down in scented undulation, steep to the blue water, studded here and there with new-mown heaps, filling all the air with fainter sweetness—look up towards the higher hills, where the waves of everlasting green roll silently into their long inlets among the shadows of the pines; and we may, perhaps, at last know the meaning of those quiet words of the 147th Psalm, "He maketh grass to grow upon the mountains."

There are also several lessons symbolically connected with this subject, which we must not allow to escape us. Observe, the peculiar characters of the grass, which adapt it especially for the service of man, are its apparent humility and cheerfulness. Its humility, in that it seems created only for lowest service—appointed to be trodden on, and fed upon. Its cheerfulness, in that it seems to exult under all kinds of violence and suffering. You roll it, and it is stronger the next day; you mow it, and it multiplies its shoots, as if it were grateful; you tread upon it, and it only sends up richer perfume. Spring comes, and it rejoices with all the earth—glowing with variegated flame of flowers

—waving in soft depth of fruitful strength. Winter comes, and though it will not mock its fellow plants by growing then, it will not pine and mourn, and turn colourless or leafless as they. It is always green; and is only the brighter and gayer for the hoar-frost.

RUSKIN.

JOHN KITTO.

[HUGH MILLER, one of the most remarkable men that Scotland has produced, was born at Cromarty in 1802. On leaving the parish school he became a stone-mason. In 1828 he published a volume of "Poems by a Stone-Mason," which eventually led to his being appointed accountant in a branch-bank in his native town. He remained, however, comparatively obscure till 1839, when his letter to Lord Brougham on the Free Church question brought him under the notice of the leaders of the Non-intrusion party, who established the "Witness" newspaper as the organ of their views, and appointed Mr. Miller the editor. His contributions in that journal have been published as "The Old Red Sandstone," and "My Schools and Schoolmasters." He also wrote the "Foot Prints of the Creator," and had just completed for the press his "Testimony of the Rocks," when, in a paroxysm of insanity, he put an end to his life in 1856. He holds the first rank as an English author for the beauty, vigour, and purity of his style.]

IT is now nearly forty years since an operative mason, somewhat dissipated in his habits, and a little boy, his son, who had completed his twelfth year only a few weeks previous, were engaged in repairing a tall, ancient domicile, in one of the humbler streets of Plymouth. The mason was employed in relaying some of the roofing; the little boy, who acted as his labourer, was busied in carrying up slates and lime along a long ladder; the afternoon was slowly wearing through, and the sun hastening to its setting; in little more than half-an-hour both father and son would have been set free from their labours for the evening; when the boy, in what promised to be one of his concluding journeys roofwards for the day, missed footing just as he was stepping on the eaves, and was precipitated on a stone pavement thirty-five feet below. Light and slim, he fared better than an adult would have done in the circumstances; but he was deprived of all sense and recollection by the fearful shock, and save that he saw for a moment the gathering crowd, and found himself carried homewards in the arms of his father, a fortnight

elapsed ere he awoke to consciousness. When he came to himself in his father's house, it was his first impression that he had outslept his proper time for rising—it was broad daylight, and there were familiar forms round his bed. He next, however, found himself grown so weak, that he could scarce move his head on the pillow; and was then struck by the profound silence that prevailed around him—a silence which seemed all the more extraordinary from the circumstance that he could see the lips of his friends in motion, and ascertain from their gestures, that they were addressing him. But the riddle was soon read. The boy, in his terrible fall, had broken no bone, nor had any of the vital organs received serious injury; but his sense of hearing was gone for ever; and for the remainder of the half-century which was to be his allotted term on earth, he was never to hear more. Knowledge at one entrance was shut out for ever. As is common, too, in such circumstances, the organs of speech became affected. His voice assumed a hollow, sepulchral tone, and his enunciation became less and less distinct, until at length he could scarce be understood by even his most familiar friends. For almost all practical purposes he became dumb as well as deaf.

Unable, too, any longer to assist in the labours of his dissipated father, he had a sore struggle for his existence, which terminated in his admission into the poor-house of the place as a pauper. And in the workhouse he was set to make list-shoes, under the superintendence of the beadle. He was a well-conditioned, docile, diligent little mute, and made on the average about a pair and a half of shoes per week, for which he received from the manager, in recognition of his well-doing, a premium of a weekly penny—a very important sum to the poor little deaf pauper. Darker days were, however, yet in store for him; he was not a little teased and persecuted by the idle children in the workhouse, who made sport of his infirmity; his grandmother, to whom he was devotedly attached, and with whom he had lived previous to his accident, was taken from him by death; and to sum up his unhappiness at this time, he was apprenticed

by the workhouse to a Plymouth shoemaker—a brutal and barbarous wretch, who treated him with the most ruthless indignity and cruelty, threw shoes at his head, boxed him on the ears, slapped him on the face, and even struck him with the broad-faced hammer used in the trade.

Suddenly, however, this dire tyranny came to a close. A few excellent men connected with the management of the workhouse had been struck by the docility and intelligence of the young mute. One of them, Mr. Burnard, a gentleman who still survives, struck by his powers of thought and expression, had furnished him with themes on which to write. He had shown him attention and kindness, and the lad naturally turned to him as a friend and protector. And, stating his case to him by letter, the good man not only got him relieved from the dire thraldom of his tyrannical master, but, by interesting a few friends in his behalf, secured for him the leisure necessary to prosecute his studies. For even when his circumstances were most deplorable, the little deaf and dumb boy had been dreaming of making himself a name in letters, by producing books which even the learned would not despise. And by means of a liberal subscription, he was now enabled to go on reading and writing with—wonderful change for him whose premium pence used to be all spent in the purchase of little volumes—the whole volumes of a subscription library at his command.

Depressed as his circumstances had hitherto been, and little favourable apparently to the development of mind, they were yet not without their peculiar balance of advantage. Lads born deaf and dumb rarely master in after life the grammar of the language; for though they acquire a knowledge of the words which express qualities and sentiments, or which represent things, they seem unable to attain to the right use of those important particles—adverbs, conjunctions, and prepositions—which, as the smaller stones in a wall serve to keep the larger ones in their places, give in speech or writing order and coherency to the others. But the deaf lad had not been born deaf—he had read and conversed, and even attempted composition, previous to his

accident; so that his grandmother could boast of the self-taught boy, not without some shadow of truth, that her "Johnnie was the best scholar in all Plymouth." And now, writing having become his easiest and most ready mode of communication—the *speech* by which he communicated his ideas—he had attained to a facility in the use of the pen, and a command of English, far from common among even university bred youths, his seniors by several years. He had acquired, too, the ability of looking at things very intently. It has been well said by the poet,

> "That oft, when one sense is suppressed,
> It but retires into the rest."

And it would seem as if the hearing of this deaf lad had retreated into his eyes—which were ever after to exercise a double portion of the seeing function. All this, however, could not be at once understood by his friends; there seemed to be but few openings through which the poor deaf and dumb lad could be expected to make his way to independence, and what is termed respectability; and it was suggested that he should set himself to acquire the art of the common printer, and attach himself to a mission of the English church still, we believe, stationed in Malta, that sends forth from its press many useful little books, chiefly for distribution in the East.

Accordingly, in a comparatively short time, the deaf lad did acquire the art of the common printer—nay, more, he became skilful in setting the Arabic character; and, having a decided turn for acquiring languages, though unable to speak them, he promised, judging from his mechanical and linguistic abilities, to be a useful operative to the Missionary. Unfortunately, however, for such was the estimate of the Mission's conductors, he was not content to be a mere operative; his instincts drew him strongly towards literature; and ere quitting England for Malta, he had such a quarrel on this score with some very excellent men, that he threw up his situation, which however, through the mediation of kind friends, he was again induced and enabled to resume. But

at Malta, where the poor deaf lad suffered much from illness, and much from wounded affections—for shut out though he was from his fellows, he had yet had his affair of the heart—the quarrel was again resumed, and he received a reprimand from the Committee of the Mission in England, which was virtually a dismissal.

Dismissed from his situation, he returned to England with but forlorn prospects. There was, however, work for him to do, and an unexpected opening, which providentially occurred shortly after his arrival, served greatly to fit him for it. A missionary friend bound for central Persia engaged him to accompany him on the journey as tutor to his two boys: a charge for which his previous studies, pursued under the direst disadvantages, adequately fitted him; and, with his eyes all the more widely open from the circumstance that his ears were shut, he travelled through Russian Europe into Persia—saw the greater and lesser Ararats—passed through the Caucasian range of mountains—loitered amid the earlier seats of the human family—forded the Euphrates near its source—resided for about two years in Bagdad—witnessed the infliction of war, famine, and pestilence; and then, his task of tuition completed, journeyed homewards by Teheran, Tabreez, Trebizond, and Constantinople, to engage in his great work.

Never did literary man toil harder or more incessantly. His career as an author commenced in 1833, and terminated at the close of 1853; and during that period he produced twenty-one separate works, some of them of profound research and great size. Among these we may enumerate the "Pictorial Bible," the "Pictorial History of Palestine," the "Cyclopædia of Biblical Literature," the "Lost Senses," "Scripture Lands," and the "Daily Bible Illustrations." And in order to produce this amazing amount of elaborate writing, Dr. Kitto used to rise, year after year, at four o'clock in the morning, and toil on till night. But the overwrought brain at length gave way, and in his fiftieth year he broke down and died. Could he have but retained the copyright of his several works, he would have been a wealthy

man; he would at least have left a competency to his family; but commencing without capital, and compelled by the inevitable expense of a growing family to labour for the booksellers, he was ever engaged in "providing," according to Johnson, "for the day that was passing over him," and died, in consequence, a poor man.

We know not a finer example than that which it furnishes of the "pursuit of knowledge under difficulties," nor of a devout and honest man engrossingly engaged in an important work, in which he was at length to affect the thinking of his age, and to instruct and influence its leading minds.

HUGH MILLER.

LOCH-NA-GARR.

[LOCH-NA-GARR is a lofty mountain in the south-west of Aberdeenshire, near which Byron spent the early part of his life, the recollection of which gave birth to these stanzas. The mountain has a dusky appearance owing to the huge boulders of greyish granite that cover its rugged sides, and the dark mists that frequently rest on its top. A small loch washes the base of the mountain.]

AWAY ye gay landscapes, ye gardens of roses!
  In you let the minions of luxury rove;
Restore me the rocks where the snow-flake reposes,
  For still they are sacred to freedom and love!
Yet, Caledonia, beloved are thy mountains,
  Round their white summits though elements war;
Though cataracts foam, 'stead of smooth flowing fountains,
  I sigh for the valley of dark Loch-na-Garr.

Ah! there my young footsteps in infancy wandered:
  My cap was the bonnet, my cloak was the plaid;
On chieftains long perished my memory pondered,
  As daily I strode through the pine-covered glade;
I sought not my home till the day's dying glory
  Gave place to the rays of the bright polar star;
For fancy was cheered by traditional story,
  Disclosed by the natives of dark Loch-na-Garr.

"Shades of the dead! have I not heard your voices
  Rise on the night-rolling breath of the gale?"

Surely the soul of the hero rejoices,
　And rides on the wind o'er his own Highland vale.
Round Loch-na-Garr, while the stormy mist gathers,
　Winter presides in his cold icy car;
Clouds there encircle the forms of my fathers,—
　They dwell in the tempests of dark Loch-na-Garr.

"Ill-starred, though brave, did no visions, foreboding,
　Tell you that fate had forsaken your cause?"
Ah! were you destined to die at Culloden?
　Victory crowned not your fall with applause;
Still were you happy in death's earthly slumber,
　You rest with your clan in the caves of Braemar;
The pibroch resounds, to the piper's loud number,
　Your deeds on the echoes of dark Loch-na-Garr.

Years have rolled on, Loch-na-Garr, since I left you,
　Years must elapse ere I tread you again;
Nature of verdure and flowers has bereft you,
　Yet still are you dearer than Albion's plain.
England! thy beauties are tame and domestic
　To one who has roved on the mountains afar;
Oh for the crags that are wild and majestic!
　The steep frowning glories of dark Loch-na-Garr.

BYRON.

NAPOLEON AND WELLINGTON.

NAPOLEON and Wellington were not merely individual characters: they were the types of the powers which they respectively headed in the contest; Napoleon had brighter genius, Wellington superior judgment: the former combated with greater energy, the latter with more perseverance. Rapid in design, instant in execution, the strokes of the French hero fell like the burning thunderbolt; cautious in counsel, yet firm in action, the resources of the British champion multiplied, like the vigour of vegetation, after the withering stroke had fallen. No campaign of Wellington's equals in

energy and activity those of Napoleon in Italy and in France; none of Napoleon's approaches in foresight and wisdom that of Wellington at Torres Vedras. The vehemence of the French Emperor would have exhausted, in a single season, the whole resources which, during the war, were at the disposal of the English general; the caution of Wellington would have alienated in the very beginning the troops which overflowed with the passions of the Revolution. Ardour and onset were alike imposed on the former by his situation, and suggested by his disposition; foresight and perseverance were equally dictated to the latter by his necessities, and in unison with his character. The one wielded at pleasure the military resources of the half of Europe, and governed a nation heedless of consequences, covetous of glory, reckless of slaughter; the other led the forces of a people distrustful of its prowess, avaricious of its blood, niggardly in the outset of its expenditure, but, when once roused, invincible in its determination. And the result, both in the general war and final struggle, was in entire conformity with this distinction. Wellington retired in the outset before the fierce assault of the French legions, but he saw them, for the first time since the Revolution, permanently recoil in defeat from the rocks of Torres Vedras. He was at first repeatedly expelled from Spain, but at last he drove the invaders with disgrace across the Pyrenees. He was in the beginning assailed unawares, and well nigh overpowered in Flanders; but in the end he baffled all Napoleon's efforts, and, rising up with the strength of a giant, crushed at once his army and his empire on the field of Waterloo.

The personal and moral characters of the two chiefs were still more strikingly opposed, and emblematic of the sides they severally led. Both were distinguished by the unwearied perseverance, the steady purpose, the magnanimous soul, which are essential to glorious achievements; both were provident in council, and vigorous in execution; both possessed personal intrepidity in the highest degree; both were indefatigable in activity, and iron in constitution; both enjoyed the rarer qualities of moral courage and fearless

determination. But, in other respects, their minds were as opposite as were the poles asunder. Napoleon was covetous of glory, Wellington was impressed with duty; Napoleon was reckless of slaughter, Wellington was sparing of blood; Napoleon was careless of his word, Wellington was inviolable in faith. Treaties were regarded by the former as binding only when expedient—alliances valid only when useful; obligations were regarded by the latter as obligatory, though ruinous—convention as sacred, even when disgraceful. Napoleon's wasting warfare converted allies into enemies; Wellington's protecting discipline changed enemies into friends. The former fell because all Europe rose up against his oppression; the latter triumphed because his principles were such that all Europe was at last glad to place itself under his guidance. There is not a proclamation of Napoleon to his soldiers in which glory is not mentioned, nor one in which duty is alluded to; there is not an order of Wellington to his troops in which duty is not inculcated, nor one in which glory is mentioned.

The intellectual characters of the heroes exhibited the same distinctive features as their military career and moral qualities. No man ever surpassed Napoleon in the clearness of his ideas, or the stretch of his glance into the depths of futurity; but he was often misled by the fervour of his conceptions, and mistook the dazzling brilliancy of genius for the steady light of truth. With less ardour of imagination, less originality of thought, less creative power, Wellington had more justness of judgment, and a far greater capability of discriminating error from truth. The young and the ardent who have life before them, will ever turn to the St. Helena memoirs for the views of a mind of the most profound and original cast on the most important subjects of human thought. The mature and the experienced who have known its vicissitudes, will rest with more confidence on the "Maxims and Opinions" of Wellington, and marvel at the numerous instances in which his instinctive sagacity and prophetic judgment had, in opposition to all around him, beheld the shadow of coming events, even amidst the

clouds with which he was surrounded. No one can read the speculations of the French Emperor without admiration at the brilliancy of his ideas, and the originality of his conceptions; none can peruse the maxims of the English general without closing the book at every page to meditate on the wisdom and justice of his opinions. The genius of the former shared in the fire of Homer's imagination; the mind of the latter exhibited the depth of Bacon's intellect.

But it was in the prevailing moral principles by which they were regulated, that the distinctive character of their minds was most striking and important. Singleness of heart was the characteristic of the British hero, a sense of duty his ruling principle; ambition pervaded the French conqueror, a thirst for glory was his invariable incentive; but he veiled it to others, and perhaps to himself, under the name of a patriotic spirit. The former proceeded on the belief that the means, if justifiable, would finally work out the end; the latter on the maxim that the end would justify the means. Napoleon placed himself at the head of Europe, and desolated it for fifteen years with his warfare; Europe, in return for Waterloo, placed Wellington at the head of its armies, and he gave it thirty years of unbroken peace. The former thought only in peace of accumulating the resources of future war; the latter sought only in war the means of securing future peace, and finally sheathing the sword of conquest. The one exhibited the most shining example of splendid talents devoted to temporal ambition and national aggrandisement; the other, the noblest instance of moral influence directed to exalted purposes and national preservation. The former was in the end led to ruin while blindly pursuing the meteor of worldly greatness; the latter was unambitiously conducted to final greatness, while only following the star of public duty. The struggle between them was the same at bottom as that which, anterior to the creation of man, shook the powers of heaven; and never was such an example of moral government afforded as the final result of their immortal contest. Wellington was a warrior, but he was so only to become a pacificator; he has

shed the blood of man, but it was only to stop the shedding of human blood; he has borne aloft the sword of conquest, but it was only to plant in its stead the emblems of mercy. He has conquered the love of glory, the last infirmity of noble minds, by the love of peace, the first grace of the Christian character.

ALISON.

THE DAY OF THE FUNERAL.

[This poem on the "Day of the Funeral" of the late Duke of Wellington in 1852, was published anonymously. It was dated from "Oriel College," Oxford.]

No sounds of labour vexed the quiet air
From morn till eve. The people all stood still,
And earth won back a Sabbath. There were none
Who cared to buy and sell, and make a gain,
For one whole day. All felt as they had lost
A father, and were fain to keep within,
Silent, or speaking little. Such a day
An old man sees but once in all his time.

The simplest peasant in the land that day
Knew somewhat of his country's grief. He heard
The knell of England's hero from the tower
Of the old church, and asked the cause, and sighed.
The vet'ran who had bled on some far field,
Fought o'er the battle for the thousandth time
With quaint addition; and the little child,
That stopped his sport to run and ask his sire
What it all meant, picked out the simple tale,—
How he who drove the French from Waterloo,
And crushed the tyrant of the world, and made
His country great and glorious,—*he* was dead.
All, from the simplest to the stateliest, knew
But one sad story—from the cotter's bairn
Up to the fair-haired lady on the throne,
Who sat within and sorrowed for her friend;
And every tear she shed became her well,

And seemed more lovely in her people's eyes
Than all the starry wonders of her crown.

But, as the waters of the Northern Sea
(When one strong wind blows steady from the pole)
Come hurrying to the shore, and far and wide
As eye can reach the creaming waves press on
Impatient; or, as trees that bow their tops
One way, when Alpine hollows bring one way
The blast whereat they quiver in the vale,—
So millions pressed to swell the general grief
One way;—for once all men seemed one way drawn;
Or if, through evil hap and unforeseen,
Some stayed behind, their hearts, at least, were there
The whole day through,—could think of nothing else,
Hear nothing else, see nothing!
In his cell
The student saw the pageant; spied from far
The long-drawn pomp which reached from west to east,
Slow moving in the silence—casque and plume
And banner waving sad; the marvellous state
Of heralds, soldiers, nobles, foreign powers,
With baton, or with pennon; princes, peers,
Judges, and dignitaries of Church and State,
And warriors grown grey-headed;—every form
Which greatness can assume or honour name,
Peaceful or warlike,—each and all were there;
Trooping in sable sorrow after him
Who slept serene upon his funeral car
In glorious rest! . . . . A child might understand
That 'twas no national sorrow, but a grief
Wide as the world. A child might understand
That all mankind were sorrowing for *one!*
That banded nations had conspired to pay
This homage to the chief who drew his sword
At the command of Duty; kept it bright
Through perilous days; and soon as Victory smiled,
Laid it, unsullied, in the lap of Peace.

ANON.

LIGHT.

Concave, (*con*, *cavus*, L.) hollow, like the inside of a cup. Hence *plano-concave* and *concavo-convex*.
Converge, (*con*, *vergo*, L.) to tend to one point. Hence *converging* and *convergent*.
Convex, (*convexus*, L.) rounded or swelling outwards, like the outside of a cup, or of a ball. Hence *convexity*, *plano-convex*, &c.
Diverge, (*di*, *vergo*, L.) to tend from a point and recede from each other. Hence *diverging*, *divergent*.
Ether, (*aether*, L. from G.) Hence *ethereal*, which often means *unsubstantial* or *heavenly*.
Focus, (L.) *Lit.* a fire-place.
Incident, (*in*, *cado*, L.) falling upon. Hence *incidence*.
Lens, (L.)
Luminous, (*lumen*, L.) emitting light. Hence also *luminary*.
Meniscus, (G.) *Lit.* a little moon.
Microscope, (*micros*, *scopeo*, G.) a magnifying glass.
Plane, (*planus*, L.) level, not curved.
Reflect, *reflection*, (*re*, *flecto*, L.)
Refract, *refraction*, *refractive*, (*re*, *frango*, L.)
Spectrum, (L.) *Plural*, *spectra*.
Speculum, (L.) a reflector; more especially one of polished metal. *Plural*, *specula*.
Stereoscope, (*stereos*, *scopeo*, G.) an optical instrument which gives the appearance of solidity to a picture.
Telescope, (*tele*, *scopeo*, G.) an instrument for seeing distant objects.

NATURE, VELOCITY, AND DIFFUSION OF LIGHT.

"WHAT would the world be without light?" is a question not easily answered. Suppose for a moment that the sun were extinguished, we cannot conceive the horrors that would ensue. Nor is it possible that those, whose eyes have always been open to the blessed light of day, can ever fully know how sad it is to spend one's life in darkness, cut off from all the knowledge, and all the pleasure, which the sense of sight affords.

Though light, and the power of perceiving it, are thus among the most precious of the Creator's gifts, and though there are few sciences so well understood as that which treats of the phenomena of vision, yet, strange to say, we cannot tell for certain what light is, or how it is conveyed from one place to another. One party maintains that it consists of incredibly small particles, issuing with inconceivable velocity from those bodies which we describe as *luminous*. Such bodies are the sun, stars, flames, &c. A very different opinion, however, is now almost universally received. According to this latter view, light is produced, like sound, by a vibratory or wavy motion. The particles of a luminous body are supposed to be in vibration, and to communicate their vibrations to an extremely subtle fluid, with which all space is supposed to be filled. This fluid, to

which the name of *ether* has been given, is regarded as a finer kind of air, through which the *light-waves* travel exactly as sound-waves travel through the atmosphere.

We are apt to speak and think of light as if it were transmitted instantaneously, or, in other words, as if it required *no time at all* to pass from one place to another. This notion is not unnatural, for its real velocity is so prodigious, that the time it would take to travel from pole to pole is too short to be measured by any ordinary means. How is such a velocity to be calculated? The earth is too limited a theatre on which to observe a motion so unparalleled in rapidity, and we are therefore compelled to have recourse to the heavenly bodies. It is well known that the earth revolves round the sun, at the distance of 95 millions of miles. Jupiter, the largest of the planets, also revolves round the sun, but at a much greater distance. Now it is clear that, when the earth and Jupiter are on opposite sides of the sun, they will be farther from each other than when they are on the same side, the difference being the whole breadth of the earth's orbit. Very accurate observations have shown, that light from Jupiter reaches the earth sixteen minutes sooner when they are at their least distance, than it does when they are at their greatest distance from one another. In sixteen minutes, therefore, light travels over a space equal to the breadth of the earth's orbit, that is, to twice the earth's distance from the sun, or 190 millions of miles. This gives a velocity of nearly 200,000 miles, or about eight times the circumference of the earth, per second!

From every point of every luminous body, light is constantly sent forth at this enormous rate. It proceeds only in straight lines, one such line being called a *ray*, and a bundle or collection of rays a *pencil* of light. Hence we cannot see through a bent tube; and hence also, when light falls on an *opaque* body, a shadow of that body is formed on the opposite side to that from which the light comes. Shadow is nothing more than the darkness caused by the absence of the rays of light which the opaque body has intercepted.

But this is not all. Bodies which are not themselves luminous, give forth again a part of any light which falls upon them, and thereby become visible. It is in this way that the light of the sun is so generally diffused in the daytime, even in the interior of houses, and in other places not exposed to his direct rays. Every illuminated object becomes a luminary in its turn, and thus, by an infinite series of successive reflections, that general illumination is produced to which we give the name of *daylight.* The atmosphere itself greatly contributes to this uniform diffusion of the solar rays. Every particle of air becomes in fact a luminous centre, which sends forth light in every direction. Were it not so, the atmosphere would be invisible, for we can see an object only when light passes from it to the eye. If, therefore, the eye ceased to receive light from this great ocean of air in which we live, the sky over our heads would lose its beautiful azure, and appear totally black.

REFLECTION OF LIGHT.

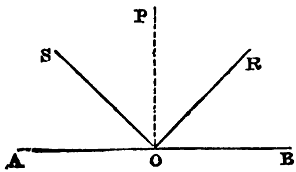
When light falls on an opaque body, part of it is always absorbed and lost, at least so far as our senses are concerned. From every point of the illuminated surface, another portion of the same light is again sent out in every direction; and we have already learned that it is by means of this *irregular* reflection, as it is often called, that bodies having no light in themselves become visible. But if the surface receiving the light is *polished,* another portion still suffers reflection of a totally different kind, according to a definite law of direction now to be explained. It is this *regular reflection from polished surfaces* which people generally mean, when they speak, without any qualifying term, of the "reflection of light."

The most familiar example of a polished reflector is a common mirror or looking-glass. In general, metallic surfaces are the best reflectors, and, even in the looking-glass, it is not the surface of the glass, but the metallic coating

on the back, which really produces the effect. This coating, which consists of an amalgam of tin and quicksilver, has an intense metallic lustre, and therefore a very high reflecting power. Glass itself reflects more feebly, as any one may see by blackening a plate of it on one side, so as to exclude light from behind, and then using the other side as a reflector. In many cases, reflectors are made by polishing metallic surfaces, without the intervention of glass. These are usually denominated *specula*, and are much employed in the construction of optical instruments.

The great law of regular reflection is easily understood.

FIG. 49.

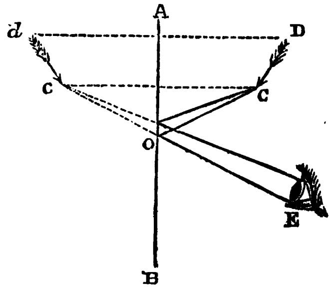


Let A O B represent a plane reflecting surface of whatever kind, and let O P be a line perpendicular to it. If a ray of light fall upon the surface A O B in the direction P O, it will be reflected in the same line from O to P. But if a ray fall slantingly on the reflector, as for example, in the line R O, it will be reflected in the direction O S, on the opposite side of the perpendicular. The line R O, be it observed, makes with the perpendicular an angle R O P, which is called the *angle of incidence;* the reflected ray makes with the perpendicular an angle S O P, which is called the *angle of reflection;* now the great principle which governs all regular reflection is, that *these two angles, the angle of incidence and the angle of reflection, are always equal to one another.* In other words, the incident ray and the reflected ray are equally oblique; the latter inclines as much, if we may so speak, to the one side, as the former does to the other side. We need not go far to find illustrations of this important law. If you stand right before a mirror, you see your own image, because the light falling upon the mirror from your body is thrown back to you. If you move a little to one side, you will see the image no longer, but a person placed as far towards the other side will see it, and his image will, in like manner, be visible to you. The rays from his

body, falling obliquely on the mirror, are reflected obliquely towards you; the rays from your body, for a similar reason, are reflected towards him.

When you look at an image of any object in a plane mirror, the image appears to be as far behind the mirror, as the object itself is before it. Suppose A B to represent a mirror with the reflecting surface turned to the right, CD an object placed before it, and *cd* the image of that object as seen by an eye at E. The point C gives forth rays in all directions, of which a small pencil, falling upon the mirror at O, is so reflected that the rays enter the eye in the same directions as if they had come from the point *c*. At this latter point, therefore, the eye perceives an image of the point C. The same is the case with the point D, whose image is formed at *d;* and since every other point of the object produces an image of itself in the same way, the general result is, that an image of the whole object is seen, equally distant from the reflector with the object itself, and similar to it in every respect, but *in a reversed position.*

FIG. 50.



For many purposes, plane reflectors are not suitable. In telescopes, for example, a concave speculum is often used, and the image which it forms of any heavenly body is viewed through a lens or eye-glass. Such an instrument is called a *reflecting* telescope. It is not possible to explain here the mode in which images are produced by concave and convex reflectors. A pretty good idea of some of the phenomena may be got by looking at the reflection of one's own face in a tea-kettle, or in a silver spoon. But it is worthy of special remark, that the image of a distant object, formed by a concave mirror, is not one which can be seen by looking *into* the mirror, but is a real picture suspended in the air a

little in front of the reflecting surface, and may be rendered visible by placing a screen in a proper position to receive it. Such is the image of the sun, for example, formed in a reflecting telescope. The spot occupied by this image is called the *focus* of the reflector. There all the rays falling upon the reflector from the sun are collected, not exactly to a point, but into a very small space. The heat in that space is intense; sufficient, in the case of a large mirror, to set wood on fire, and melt silver and copper coins.

It has already been stated, that only a part of the light falling on any polished surface is reflected. This may, perhaps, be owing to the want of perfect polish. But it has to be borne in mind that the actual quantity reflected depends not only on the nature of the reflector, but also on the direction of the incident rays. The more oblique their course, the larger is the proportion reflected. Take as an example the surface of still water, which reflects but feebly. Very seldom, and only in favourable circumstances, can one see his own image reflected with anything like distinctness by a sheet of water. He may bend over it, but the only rays from his own body which can reach his eye after reflection are so near the perpendicular, that very few of them are reflected at all. Yet it is no uncommon thing to see, by reflection from the calm surface of a lake, a distinct inverted image, apparently stretching far down into its azure depths, of the trees, cliffs, precipices, and mountains on the farther shore. One such observation has been recorded by a devout lover of nature, in language whose very simplicity gives it beauty:—

> "The swan in still Saint Mary's Lake
> Floats double, swan and shadow!"
>
> WORDSWORTH.

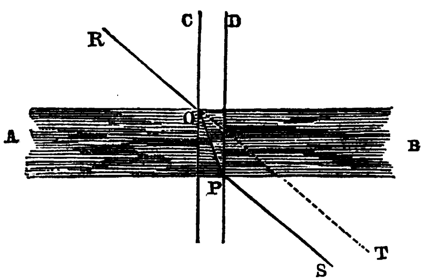
REFRACTION OF LIGHT.

As the light which falls upon a polished surface is never wholly reflected, so the light which enters a transparent substance, or *medium*, is never wholly transmitted. Some

portion of it is always absorbed in its course. Thus a mountain looks dim and shadowy when seen from a great distance, because of the vast mass of air between it and the eye; and even the light of the sun is partly absorbed in passing through the atmosphere.

When a pencil of light passes from one transparent medium into another of a different kind, or of different density, there is not only a part of it reflected, and another part absorbed, but the remainder is turned out of its course, and enters the new medium in a different direction from that which it has already pursued. This effect is termed *refraction*. Suppose, for example, that AB is a plate of glass of equal thickness throughout, and that CO and DP are perpendicular to either of its two parallel surfaces. If a ray fall upon the upper surface of the glass at O, in the direction of the perpendicular CO, it will not be refracted, but will continue its course right through the plate in the same straight line. But it is not so in the case of a ray which falls on the glass in any other direction, as R O. Instead of pursuing a straight course towards T, such a ray will be bent (or rather broken) at O, and will proceed towards P, in the straight line O P. It will be observed that O P is less oblique than R O; in other words, the ray has been refracted in passing from air into glass, *towards* the perpendicular. When the refracted ray arrives at P, and emerges again from the glass into the air, a somewhat similar change will take place; but this time it will be turned into a more oblique direction, or bent *farther away from* the perpendicular. And the result of the two refractions is, that the

FIG. 51.

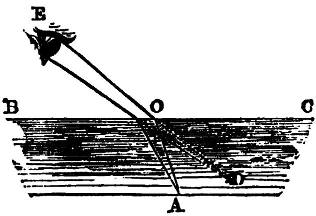


ray now proceeds in a direction P S, parallel to the line R T, in which it would have proceeded, had it not been refracted at all. It is obvious, however, that this will not be the case, unless the refracting surfaces are parallel.

As a general rule, a ray passing from a rarer to a denser medium is bent towards the perpendicular, and a ray passing from a denser to a rarer medium is bent away from the perpendicular. But this is not always quite true; for certain substances have a stronger refractive power than others of equal, or even greater density.

A few curious effects of refraction may now be explained.

FIG. 52.



Let the point A represent a pebble at the bottom of a stream or pond, B C being the surface of the water. A small pencil of rays, issuing from A, will be refracted at O, away from the perpendicular, so as to reach an eye at E; and the rays will enter the eye in the same directions as if they came from the point D. The pebble will therefore be seen, not at A *where it really is*, but at D *where it is not;* and since every point of the solid bottom on which the pebble rests will be raised in the same way, the water will appear much shallower than it actually is. Have you never found, when wading or bathing in a clear stream, that it was deeper than you supposed? If so, you will now readily understand the cause; and you will also see that it is a good rule, especially if you cannot swim, to make due allowance, in estimating the depth of water, for this singular species of deception.

There is a pretty and easily made experiment illustrative of this subject. Place in the bottom of a cup or basin any small object, such as a shilling or a halfpenny, and stand in such a position that the edge of the vessel shall just conceal the coin from your view. Then let some other person pour water into the basin, while you retain your position. The

coin which before was invisible, will now seem to rise into view, the rays issuing from it being refracted so as to reach the eye. From what has been already explained, it is manifest that the effect will be the same as if the coin were removed from A to D (fig. 52).

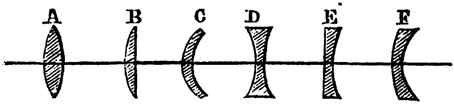
Another experiment, still more simple, is equally instructive. If a straight rod be dipped slantingly in water, it appears crooked, or rather it appears to consist of *two* straight rods, one in the water and one above it, joined together at a very obtuse angle. The reason is, that every point below the surface of the water is seen out of its true position, the displacement increasing as the depth increases.

The atmosphere has not only the power of refracting light, but, since it consists of strata constantly increasing in density as they are nearer the earth's surface, a ray passing slantingly downwards is more and more refracted in each successive stratum. Hence the light from the sun, or from any other heavenly body (unless that body be right overhead) always describes, in the last part of its course, a slightly curvilinear path. In so doing, it tends more and more towards the perpendicular. Now the body from which light comes is seen in the direction in which the rays finally enter the eye, and hence it follows that we see the sun, moon, and stars, a little nearer the zenith than they really are. Their displacement increases as they approach the horizon, and when they are really on the horizon, we see them considerably above it. More remarkable still is the fact that, in the very same way, we actually see them for a short time after they are *below* the horizon. The rays of light which come from them to us are bent round the earth's convexity, much in the same way as the rays from the coin, in the experiment described above, are bent round the edge of the cup or basin in which it is placed.

Upon refraction depends, in a great measure, the value of those numerous optical instruments, such as spectacles, telescopes, microscopes, magic-lanterns, cameras, and stereoscopes, which have contributed so much to the convenience, instruction, and amusement of mankind. In all these

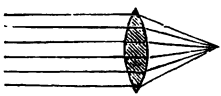
instruments, one or more refracting lenses are essential. Such lenses are usually made of glass, and are of six kinds, according as their surfaces are convex, plane, or concave. Three of them, the *double convex* (A), *plano-convex* (B), and *meniscus* (C), are thicker towards the centre than at the edges, and collect parallel rays falling upon them to a common point or *focus* beyond, as in fig. 54.

FIG. 53.



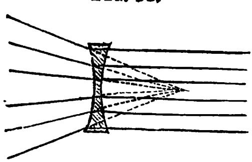
They are therefore called *converging* lenses. The other three, the *double concave* (D), the *plano-concave* (E), and the *concavo-convex* (F), which are thickest at the edges, are called *diverging* lenses, because parallel rays, after being refracted by them, diverge or spread outwards, as if they came from a focus on the same side.

FIG. 54.



This is shown in fig. 55. If the rays falling upon the lenses are not parallel, the effect is substantially the same; converging lenses tend to *gather* them, diverging lenses to *scatter* them. Hence the rays from any object which we wish to examine may be made to enter the eye, by means of a suitable combination of lenses, or of lenses and reflectors together, in any desired direction. By the same means magnified images may be produced of objects too small to be seen by the naked eye; and the dim light from objects far beyond the reach of unassisted vision may be so collected and concentrated as to render these objects distinctly visible. It is thus that the telescope has revealed to us thousands of worlds in the remote regions of space, of whose existence we should otherwise have been ignorant; while, on the other hand, the microscope has made us acquainted with other worlds within and around us, filled with creatures of

FIG. 55.



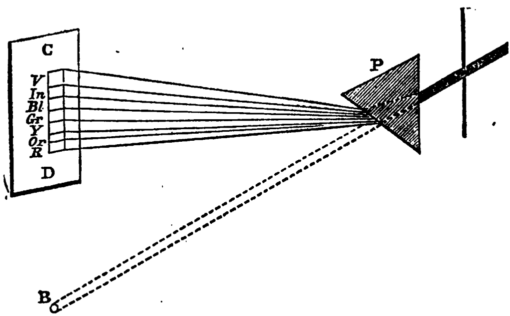
inconceivable minuteness, and has extended as far downwards, as the telescope has extended it upwards, our knowledge of the great Creator's handiwork.

COLOURS—THE RAINBOW.

When anything can be resolved or decomposed into distinct parts, each part having different properties, we say that it is *compound*. Now it has been found, astonishing as the fact may appear, that a ray of white light is capable of such decomposition.

Let a small hole be made in a window-shutter, so as to admit into a darkened room a beam of sunlight. This beam, falling upon the opposite wall, will there illuminate a small spot, as at B (fig. 56), which will be, in fact, a

Fig. 56.



more or less perfect image of the sun. Suppose now that a glass *prism* P is interposed. The light will of course be refracted, but it will neither be brought to a focus, as it would be by a converging lens, nor transmitted in a direction parallel to its former course, as it would be by a plate of glass of uniform thickness. According to the laws of refraction already explained, we should expect it to be bent upwards, and to form an image of the sun somewhere towards C. And this really does happen, but another and

unexpected effect is at the same time produced. Instead of a round white spot, we find that the image now assumes an oblong form, extending from C to D, and exhibiting all the colours of the rainbow. Hence it is inferred, that each ray of white light is divisible into rays of different colours, some of which are more refrangible than others, and have therefore been bent farther away from their original course.

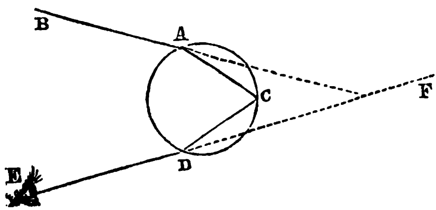
The beautiful phenomenon just mentioned has been denominated the *solar* or *prismatic spectrum.* Its colours gradually melt into each other, so that it is not possible to say exactly where one ends and another begins. Nor are the learned quite at one as to their number. It is usual, however, to reckon seven—*red, orange, yellow, green, blue, indigo,* and *violet.* The red light, being the least refrangible, occupies the lower part of the spectrum; the violet, being the most refrangible, occupies the upper part. The other colours appear in intermediate positions, as indicated in the figure. Thus a ray of pure white light, passing through a piece of colourless glass, is resolved into distinct and even brilliant colours, and the conclusion is therefore inevitable that these colours must be in the light itself.

Having gone thus far, it is not difficult to conclude, that the colours of all the objects which we see around us, are dependent on the power which these objects have of reflecting particular kinds of light. A rose appears red, because it reflects the red rays, while it absorbs all or nearly all the rest; and the same thing is true of other colours. But if a rose be placed in blue light, it will appear of a dingy bluish colour; *dingy,* because it reflects but few of the blue rays, its nature being to reflect red. If it reflected no light at all, it would appear totally black. Colour, then, is not anything inherent in the bodies themselves, to which we are wont to attribute it. It exists only in the light which illuminates them, and which they reflect. No body can appear red or blue, unless there be red or blue rays in the light which falls upon it.

The rainbow is not only one of the most beautiful objects

in nature, but it is also among the best illustrations of the decomposition of light. The mode in which it is produced is not very difficult to understand. Suppose A D to be a drop of rain, on which a ray of sunlight falls in the direction B A. It will be refracted towards the perpendicular, and divided into rays of different colours, which will take different directions according to their refrangibility.

Fig. 57.



Suppose the red ray, after refraction, to proceed to C. From C it will be *reflected* to D, and thence, after another refraction, it will proceed towards E. An eye placed at E, therefore, will see a red image of the sun in the direction of F. The same eye will perceive a violet image formed by some drop or drops a little below A D, and, in the same way, the intervening drops will send towards E rays of orange, yellow, green, blue, and indigo. Thus, within a certain space in the rain-cloud, all the colours will appear, and in the same order as in the prismatic spectrum, except that the violet will be downwards. It will be observed that the sun is supposed to be in the direction A B at the time when the rainbow appears. The red image is seen in the direction E F, which makes a certain angle with A B. Now if we trace out a circle in the sky, such that a line drawn from the eye to any point of it shall make the same angle with A B that E F does, it is obvious that rain-drops in any part of that circle will give forth red light. Thus an arch of red light will be seen in the rain-cloud. In the same way there will be an orange arch, a yellow arch, and so on; in short, there will be a rainbow. Even a second rainbow may frequently be seen, faint and shadowy, outside the first. It is accounted for exactly in the same way, except that the rays which form it are twice reflected.

Hence this splendid phenomenon, so brilliant, so spacious, so ethereal, so deeply associated in our fancy with all that is bright and heavenly, is found to be the simple offspring of rain and sunshine. We are taught in Scripture to regard it as the symbol of God's gracious promise, that He will no more destroy the earth's inhabitants by a deluge. But it is only by His special appointment, and not from anything in its own nature, that it possesses such a significance. In itself, it tells only of light shining upon drops of water, and of the gorgeous hues which that light contains. It is connected, in its physical causes, with the greenness of the grass, the varied beauty of flowers, the gay plumage of birds, the glories of a summer sunset, and every other display of those magnificent colours which lie concealed in the sunlight, till they are extracted from it for our enjoyment and delight.

QUESTIONS FOR EXAMINATION.

What do we know of the nature of light? State two opinions. Give examples of luminous bodies. What is ether supposed to be? How is the velocity of light ascertained? What is its velocity? What is a ray of light? a pencil of light? a shadow? How do we see bodies which have no light in themselves? How is the light of the sun so universally diffused? What is meant by the "reflection" of light? What are mirrors made of? What are *specula?* Explain the great law of reflection. Give examples. Show how images are formed in a plane mirror. What is remarkable about the images formed by a concave mirror? What is meant by the *focus* of a mirror? Show that the quantity of light reflected at any surface is variable. What is refraction? Trace the course of a ray through a sheet of plane glass. How is the apparent depth of water affected by refraction? Explain the experiment of the coin and basin. Why does a rod dipped slantingly in water appear crooked? What atmospheric effects are due to refraction? What are lenses? Divide them into two classes, and explain the effects of each. How is light shown to be compound? Describe the spectrum. To what are the colours of natural objects attributable? Show that they are not in the objects themselves. How is the rainbow formed? Why is there sometimes a second rainbow? Why do we see an arch of colours, and not simply a spectrum?

SECTION V.

BERNARDO DE CARPIO.

[DON SANCHO COUNT SALDANA of Spain had been imprisoned by King Alphonso of Asturias; and his son, Bernardo de Carpio, on coming of age, took up arms to effect his father's release. A long war ensued, and Alphonso at length promised to release the Count on condition that Bernardo should deliver up to him his castle of Carpio. To this Bernardo consented, and surrendered the castle. But in the meantime the treacherous king had caused Count Saldana to be slain, and his dead body to be placed on horseback, to deceive for a time his dutiful son.]

THE warrior bowed his crested head, and tamed his heart of fire,
And sued the haughty king to free his long-imprisoned sire;
"I bring thee here my fortress keys, I bring my captive train;
I pledge my faith, my liege, my lord—oh! break my father's chain!"

"Rise! rise! even now thy father comes, a ransomed man this day;
Mount thy good steed, and thou and I will meet him on his way."
Then lightly rose that loyal son, and bounded on his steed;
And urged, as if with lance in hand, his charger's foaming speed.

And lo! from far, as on they pressed, there came a glittering band,
With one that 'mid them stately rode, as a leader in the land:
"Now haste, Bernardo, haste! for there, in very truth, is he,
The father—whom thy grateful heart hath yearned so long to see."

His dark eye flashed, his proud breast heaved, his cheek's blood
came and went;
He reached that grey-haired chieftain's side, and there dismounting
bent;
A lowly knee to earth he bent, his father's hand he took;—
What was there in its touch that all his fiery spirit shook?

That hand was cold—a frozen thing—it dropped from his like lead,
He looked up to the face above—the face was of the dead;
A plume waved o'er that noble brow—the brow was fixed and
white;
He met at length his father's eyes, but in them was no sight!

Up from the ground he sprang, and gazed; but who can paint that
gaze?
They hushed their very hearts who saw its horror and amaze:
They might have chained him, as before that noble form he stood—
For the power was stricken from his arm, and from his cheek the
blood.

"Father!" at length he murmured low, and wept like childhood then—
(Talk not of grief till thou hast seen the tears of warlike men)—
He thought on all his glorious hopes, on all his high renown;
Then flung the falchion from his side, and in the dust sat down.

And, covering with his steel-gloved hand his darkly mournful brow,
"No more, there is no more," he said, "to lift the sword for now;
My king is false! my hope betrayed! my father—oh, the worth,
The glory, and the loveliness, are passed away from earth!"

Up from the ground he sprang once more, and seized the monarch's rein,
Amid the pale and wildered looks of all the courtier train;
And with a fierce, o'ermastering grasp, the rearing war-horse led,
And sternly set them face to face, the king before the dead.

"Came I not forth upon thy pledge, my father's hand to kiss?
Be still! and gaze thou on, false king! and tell me what is this?
The voice, the glance, the heart I sought—give answer, where are they?
If thou wouldst clear thy perjured soul, send life through this cold clay!

Into these glassy eyes put light—be still, keep down thine ire—
Bid these white lips a blessing speak—this earth is *not* my sire!
Give me back him for whom I strove, for whom my blood was shed;
Thou canst not—and a king!—his dust be mountains on thy head!"

He loosed the steed—his slack hand fell;—upon the silent face
He cast one long, deep, troubled look, then turned from that sad place:
His hope was crushed—his after-fate untold in martial strain—
His banner led the spears no more amidst the hills of Spain!

MRS. HEMANS.

A SHIP SINKING.

HER giant form, o'er wrathful surge, through blackening storm, majestically calm, would go 'mid the deep darkness, white as snow! But gently now the small waves glide, like playful lambs o'er a mountain's side. So stately her bearing, so proud her array, the main she will traverse for ever and aye. Many ports will exult at the gleam of her mast;—Hush! hush! thou vain dreamer!—this hour is her last!

Five hundred souls, in one instant of dread, are hurried o'er the deck; and fast the miserable ship becomes a lifeless wreck! Her keel hath struck on a hidden rock, her planks are torn asunder, and down come her masts with a reeling shock, and a hideous crash, like thunder! Her sails are draggled in the brine, that gladdened late the skies; and her pennant, that kissed the fair moonshine, down many a fathom lies. Her beauteous sides, whose rainbow hues gleamed softly from below, and flung a warm and sunny

flush o'er the wreaths of murmuring snow, to the coral rocks are hurrying down, to sleep amid colours as bright as their own.

Oh! many a dream was in the ship an hour before her death; and sights of home with sighs disturbed the sleeper's long-drawn breath. Instead of the murmur of the sea, the sailor heard the humming tree, alive through all its leaves;—the hum of the spreading sycamore that grows before his cottage door, and the swallow's song in the eaves. His arms enclosed a blooming boy, who listened, with tears of sorrow and joy, to the dangers his father had passed; and his wife—by turns she wept and smiled, as she looked on the father of her child returned to her heart at last! He wakes at the vessel's sudden roll, and the rush of waters is in his soul! Astounded, the reeling deck he paces, 'mid hurrying forms and ghastly faces;—the whole ship's crew are there! Wailings around and overhead—brave spirits stupified or dead—and madness and despair!

Now is the ocean's bosom bare, unbroken as the floating air; the ship hath melted quite away, like a struggling dream at break of day. No image meets my wandering eye, but the new-risen sun and the sunny sky. Though the night shades are gone, yet a vapour dull, bedims the wave so beautiful; while a low and melancholy moan mourns for the glory that hath flown!

WILSON.

ON THE DOWNFALL OF POLAND.

OH! sacred Truth! thy triumph' ceased a while,
And Hope, thy sister, ceased with thee to smile,
When leagued Oppression' poured to Northern wars'
Her whiskered pandoors' and her fierce hussars,
Waved her dread standard' to the breeze of morn,
Pealed her loud drum, and twanged her trumpet-horn:
Tumultuous horror' brooded o'er her van,
Presaging wrath to Poland—and to man!

Warsaw's last champion, from her height' surveyed,
Wide o'er the fields, a waste of ruin laid,—
Oh, Heaven! he cried, my bleeding country' save!
Is there no hand on high' to shield the brave?
Yet, though Destruction' sweep those lovely plains,
Rise, fellow-men! our country' yet remains!
By that dread name' we wave the sword on high!
And swear' for her' to live!—with her' to die!

He said, and on the rampart heights' arrayed
His trusty warriors, few, but undismayed;
Firm-paced and slow, a horrid front' they form,
Still' as the breeze, but dreadful' as the storm;
Low murmuring sounds' along their banners' fly,
Revenge, or death,—the watchword and reply:
Then pealed the notes' omnipotent to charm,
And the loud tocsin' tolled their last alarm!—

In vain, alas! in vain, ye gallant few!
From rank to rank' your volleyed thunder' flew;—
Oh! bloodiest picture' in the book of Time,
Sarmatia' fell, unwept, without a crime;

Found not a generous friend, a pitying foe,
Strength' in her arms, nor mercy' in her woe!
Dropped' from her nerveless grasp' the shattered spear,
Closed her bright eye, and curbed her high career;—
Hope, for a season, bade the world farewell,
And Freedom' shrieked—as KOSCIUSKO' fell!

The sun' went down, nor ceased the carnage there,
Tumultuous murder' shook the midnight air—
On Prague's proud arch' the fires of Ruin' glow,
His blood-dyed waters' murmuring far below;
The storm' prevails, the rampart' yields a way,
Bursts' the wild cry' of horror and dismay!
Hark! as the smouldering piles' with thunder' fall,
A thousand shrieks' for hopeless mercy' call!
Earth shook—red meteors' flashed along the sky,
And conscious nature' shuddered at the cry!

Departed spirits' of the mighty dead!
Ye' that at Marathon' and Leuctra' bled!
Friends of the world! restore your swords to man,
Fight' in the sacred cause, and lead the van!
Yet' for Sarmatia's tears of blood' atone,
And make her arm' puissant as your own!
Oh! once again' to Freedom's cause' return
The patriot TELL—the BRUCE of BANNOCKBURN!

CAMPBELL.

THE GLADIATOR.

I SEE before me the Gladiator lie: he leans upon his hand—his manly brow consents to death, but conquers agony, and his drooped head sinks gradually low—and through his sides the last drops, ebbing flow from the red gash, fall heavy, one by one, like the first of a thunder-shower; and now the arena swims around him!—He is gone, ere ceased the inhuman shout which hailed the wretch who won. He heard it, but he heeded not: his eyes were with his heart, and that was far away: he recked not of the life he lost, nor prize; but where his rude hut by the Danube lay, there were his young barbarians all at play, there was their Dacian mother—he, their sire, butchered to make a Roman holiday! All rushed with his blood. Shall he expire, and unavenged? Arise! ye Goths, and glut your ire!

BYRON.

TELL'S ADDRESS TO HIS NATIVE MOUNTAINS.

YE crags and peaks, I'm with you once again,
I hold to you the hands you first beheld,
To show they still are free. Methinks I hear
A spirit in your echoes answer me,
And bid your tenant welcome to his home
Again!—O sacred forms, how proud you look,

How high you lift your heads into the sky,
How huge you are, how mighty, and how free!
Ye are the things that tower, that shine—whose smile
Makes glad—whose frown is terrible—whose forms,
Robed or unrobed, do all the impress wear
Of awe divine! Ye guards of liberty,
I'm with you once again! I call to you
With all my voice! I hold my hands to you,
To show they still are free! I rush to you,
As though I could embrace you!

Scaling yonder peak,
I saw an eagle wheeling near its brow,
O'er the abyss:—his broad expanded wings
Lay calm and motionless upon the air,
As if he floated there without their aid,
By the sole act of his unlorded will,
That buoyed him proudly up. Instinctively
I bent my bow; yet kept he rounding still
His airy circle, as in the delight
Of measuring the ample range beneath
And round about; absorbed, he heeded not
The death that threatened him. I could not shoot—
'Twas liberty! I turned my bow aside,
And let him soar away.

KNOWLES.

THE RUINED COTTAGE.

NONE will dwell in that cottage, for they say oppression reft it from an honest man, and that a curse clings to it: hence the vine trails its green weight of leaves upon the ground; hence weeds are in that garden; hence the hedge, once sweet with honeysuckle, is half dead; and hence the grey moss on the apple tree. One once dwelt there, who had been in his youth a soldier; and when many years had passed, he sought his native village, and sat down to end his days in peace. He had one child—a little laughing thing, whose large dark eyes, he said, were like the mother's he had left buried in a stranger's land. And time went on in comfort and content:—and that fair girl had grown far taller than the red-rose tree her father planted her first English birth-day; and he had trained it up against an ash till it became his pride;—it was so rich in blossom and in beauty, it was called the tree of Isabel. 'Twas an appeal to all the better feelings of the heart, to mark their quiet happiness;—their home—in truth a home of love; and, more than all, to see them on the Sabbath, when they came among the first to church, and Isabel, with her bright colour and her clear glad eyes, bowed down so meekly in the house of prayer; and in the hymn her sweet voice audible: her father looked so fond of her, and then from her looked up so thankfully to Heaven! And their small cottage was so very neat; their garden filled with fruits, and herbs, and flowers; and in the winter there was no fireside so cheerful as their own.

But other days and other fortunes came—an evil power! They bore against it cheerfully, and hoped for better times; but ruin

came at last; and the old soldier left his own dear home, and left it for a prison! 'Twas in June, one of June's brightest days:—the bee, the bird, the butterfly, were on their lightest wings; the fruits had their first tinge of summer light; the sunny sky, the very leaves seemed glad; and the old man looked back upon his cottage, and wept aloud. They hurried him away and the dear child that would not leave his side. They led him from the sight of the blue heaven and the green trees, into a low, dark cell, the windows shutting out the blessed sun with iron grating; and for the first time he threw him on his bed, and could not hear his Isabel's good night! But the next morn she was the earliest at the prison gate, the last on whom it closed; and her sweet voice and sweeter smile made him forget to pine.

She brought him every morning fresh wild flowers; but every morning could he mark her cheek grow paler and more pale, and her low tones get fainter and more faint, and a cold dew was on the hand he held. One day, he saw the sunshine through the grating of his cell—yet Isabel came not; at every sound his heart-beat took away his breath—yet still she came not near him! For one sad day he marked the dull street through the iron bars that shut him from the world; at length he saw a coffin carried carelessly along, and he grew desperate—he forced the bars, and he stood on the street free and alone! He had no aim, no wish for liberty—he only felt one want, to see the corpse that had no mourners. When they set it down, ere it was lowered into the new-dug grave, a rush of passion came upon his soul, and he tore off the lid—and saw the face of Isabel, and knew he had no child! He lay down by the coffin quietly—his heart was broken! MRS. MACLEAN.

THE COTTER'S SATURDAY NIGHT.

[ROBERT BURNS, Scotland's greatest poet, was born near Ayr in 1759, and died in 1796. He received but a limited English education, to which he afterwards added an acquaintance with Latin, French, and Mathematics. After having been unfortunate in the various attempts to gain a living by agricultural and other pursuits, he was appointed an excise officer. As a poet, his rich humour, pathos, and energy, have never been surpassed.]

THE cheerfu' supper done, wi' serious face,
  They round the ingle form a circle wide;
The sire turns o'er, wi' patriarchal grace,
  The big ha' Bible—ance his father's pride;
His bonnet reverently is laid aside,
  His lyart haffets, wearing thin and bare;
Those strains that once did sweet in Zion glide,
  He wales a portion with judicious care;
And "Let us worship God!" he says, with solemn air.

They chaunt their artless notes in simple guise,
  They tune their hearts—by far the noblest aim;
Perhaps Dundee's wild warbling measures rise,
  Or plaintive Martyrs, worthy of the name;

Or noble Elgin beats the heavenward flame,
  The sweetest far of Scotia's holy lays;
Compared with these, Italian trills are tame:
  The tickled ears no heartfelt raptures raise;
Nae unison hae they with our Creator's praise.

The priest-like father reads the sacred page,
  How Abram was the friend of God on high;
Or Moses bade eternal warfare wage
  With Amalek's ungracious progeny;
Or how the royal Bard did groaning lie
  Beneath the stroke of Heaven's avenging ire;
Or Job's pathetic plaint, and wailing cry;
  Or rapt Isaiah's wild, seraphic fire;
Or other holy seers that tune the sacred lyre.

Perhaps the Christian volume is the theme,
  How guiltless blood for guilty man was shed;
How He, who bore in heaven the second name,
  Had not on earth whereon to lay his head;
How his first followers and servants sped:
  The precepts sage they wrote to many a land:
How he, who lone in Patmos banished,
  Saw in the sun a mighty angel stand;
And heard great Babylon's doom pronounced by Heaven's command.

Then, kneeling down to heaven's Eternal King,
  The saint, the father, and the husband prays;
Hope springs exulting on triumphant wing,
  That thus they all shall meet in future days;
There ever bask in uncreated rays,
  No more to sigh, or shed the bitter tear;
Together hymning their Creator's praise,
  In such society—yet still more dear;
While circling time moves round in an eternal sphere.

* * * * * *

From scenes like these old Scotia's grandeur springs,
  That makes her loved at home, revered abroad:
Princes and lords are but the breath of kings,
  "An honest man's the noblest work of God;"
And certes, in fair virtue's heavenly road,
  The cottage leaves the palace far behind;
What is a lordling's pomp?—a cumbrous load,
  Disguising oft the wretch of human kind,
Studied in arts of hell, in wickedness refined!

O Scotia! my dear, my native soil!
  For whom my warmest wish to heaven is sent;
Long may thy hardy sons of rustic toil
  Be blest with health, and peace, and sweet content!
And, oh! may Heaven their simple lives prevent
  From luxury's contagion, weak and vile!
Then, howe'er crowns and cornets be rent,
  A virtuous populace may rise the while,
And stand a wall of fire, around their much-loved Isle.

Oh, thou! who poured the patriotic tide
  That streamed through Wallace's undaunted heart,
Who dared to nobly stem tyrannic pride,
  Or nobly die,—the second glorious part,
(The patriot's God, peculiarly thou art;
  His friend, inspirer, guardian, and reward!)
Oh, never, never, Scotia's realm desert;
  But still the patriot, and the patriot bard,
In bright succession raise—her ornament and guard!

BURNS.

MARY QUEEN OF SCOTS.

I LOOKED far back| into other years, and lo! in bright array,
I saw, as in a dream, the forms of ages| passed away.
It was a stately convent, with its old| and lofty walls,
And gardens, with their broad| green walks, where soft| the footstep falls;
And o'er the antique dial-stones| the creeping shadow| passed,
And all around| the noon-day sun| a drowsy radiance| cast.
No sound of busy life| was heard, save, from the cloister| dim,
The tinkling| of the silver bell, or the sisters' holy hymn,
And there five noble maidens| sat, beneath the orchard trees,
In that first budding spring of youth, when all its prospects| please;
And little recked they, when they sang, or knelt at vesper-prayers,
That Scotland| knew no prouder names—held none| more dear| than theirs;—
And little| even the loveliest| thought, before the Virgin's shrine,
Of royal blood, and high descent| from the ancient| Stuart line;
Calmly| her happy days| flew on, uncounted| in their flight,
And, as they flew, they left| behind| a long-continuing light.

The scene| was changed. It was the court—the gay court of Bourbon—
And 'neath a thousand silver lamps, a thousand courtiers| throng;
And proudly kindles| Henry's eye—well pleased, I ween, to see
The land| assemble all its wealth of grace| and chivalry;—
Grey Montmorency, o'er whose head| has passed a storm of years,
Strong in himself and children| stands, the first| among his peers;
And next| the Guises, who| so well| fame's steepest heights| assailed,
And walked ambition's diamond ridge, where bravest hearts| have failed—
And higher yet| their path shall be, stronger| shall wax| their might,
For| before them| Montmorency's star| shall pale its waning light.
Here Louis, Prince of Condé, wears his all-unconquered sword,
With great Caligni by his side—each name| a household word!
And there| walks she of Medicis—that proud| Italian line,
The mother| of a race of kings—the haughty Catherine!
The forms| that follow in her train, a glorious sunshine make—
A milky way of stars| that grace a comet's glittering wake;
But fairer far| than all the rest, who bask on fortune's tide,
Effulgent| in the light of youth, is she, the new-made bride!
The homage| of a thousand hearts—the fond, deep love of one—
The hopes| that dance around a life| whose charms| are but begun—

They lighten up her chestnut eye, they mantleˡ o'er her cheek,
They sparkleˡ on her open brow, and high-soul'd joyˡ bespeak.
Ah! who shall blame, if scarce that day, through all its brilliant hours,
She thought of that quiet convent's calm, its sunshine, and its flowers?

The sceneˡ was changed. It was a barkˡ that slowly held its way,
And o'er its leeˡ the coast of Franceˡ in the light of eveningˡ lay;
And on its deckˡ a lady sat, who gazed with tearful eyesˡ
Upon the fast-receding hills, that dimˡ and distantˡ rise.
No marvelˡ that the lady wept—there was no land on earthˡ
She lovedˡ like that dear land, although she owed it not her birth;
It was her mother's land, the land of childhoodˡ and of friends—
It was the landˡ where she had foundˡ for all her griefsˡ amends—
The landˡ where her dead husbandˡ slept—the landˡ where she had known
The tranquil convent's hushed repose, and the splendours of a throne;
No marvelˡ that the ladyˡ wept—it was the land of France—
The chosen home of chivalry—the garden of romance!
The pastˡ was bright, like those dear hillsˡ so far behind her bark:
The future, like the gathering night, was ominousˡ and dark!
One gaze again—one long, last gaze—"Adieu, fair France, to thee!"
The breezeˡ comes forth—she is aloneˡ on the unconscious sea.

The sceneˡ was changed. It was an eveˡ of raw and surly mood,
And in a turret-chamber highˡ of ancient Holyroodˡ
Sat Mary, listening to the rain, and sighingˡ with the winds,
That seemed to suit the stormy stateˡ of men's uncertain minds.
The touch of careˡ had blanched her cheek—her smileˡ was sadder now,
The weight of royaltyˡ had pressed too heavyˡ on her brow;
And traitors to her councilsˡ came, and rebelsˡ to the field;
The Stuart *sceptre*ˡ well she swayed, but the *sword*ˡ she could not wield.
She thought of all her blighted hopes—the dreamsˡ of youth's brief day,
And summoned Rizzioˡ with his lute, and bade the minstrelˡ play
The songsˡ she loved in early years—the songsˡ of gay Navarre,
The songs perchanceˡ that erst were sungˡ by gallant Chatelar:
They half beguiled herˡ of her cares, they soothed herˡ into smiles,
They won her thoughtsˡ from bigot zeal, and fierceˡ domestic broils:—
But hark! the tramp of armed men! the Douglas battle cry!
They come—they come—and lo! the scowlˡ of Ruthven's hollow eye!
And swordsˡ are drawn, and daggersˡ gleam, and tearsˡ and wordsˡ are vain,
The ruffian steelˡ is in his heart—the faithful Rizzio's slain!
Then Mary Stuartˡ brushed aside the tearsˡ that trickling fell:
"Nowˡ for my father's arm!" she said; "my woman's heartˡ farewell!"

The sceneˡ was changed. It was a lake, with oneˡ smallˡ lonely isle,
And there, within the prison-wallsˡ of its baronial pile,
Stern menˡ stood menacing their queen, till sheˡ should stoop to sign
The traitorous scrollˡ that snatched the crownˡ from her ancestral line:—

"My lords, my lords!" the captive said, "were Iˈ but once more free,
With ten good knightsˈ on yonder shore, to aid my cause and me,
That parchmentˈ would I scatter wideˈ to every breezeˈ that blows,
And once more reignˈ a Stuart queenˈ o'er my remorseless foes!"
A red spotˈ burned upon her cheek—streamedˈ her rich tresses down,
She wrote the words—she stood erect—a queenˈ without a crown!

The sceneˈ was changed. A royal hostˈ a royal bannerˈ bore,
And the faithful of the landˈ stood round their smiling queen once more:
She staid her steedˈ upon a hill—she saw themˈ marching by—
She heard their shouts—she read successˈ in every flashing eye;—
The tumult of the strifeˈ begins—it roars—it dies away;
And Mary's troopsˈ and banners now, and courtiers—where are they?
Scatteredˈ and strewn, and flying far, defencelessˈ and undone—
O God! to see what sheˈ has lost, and think what guilt has won!
Away! away! thy gallant steedˈ must act no laggard's part;
Yet, vain his speed, for thouˈ dost bear the arrow in thy heart.

The sceneˈ was changed. Beside the blockˈ a sullen headsmanˈ stood,
And gleamed the broad axeˈ in his hand, that soonˈ must drip in blood.
With slowˈ and steady stepˈ there came a ladyˈ through the hall,
And breathless silenceˈ chained the lips, and touched the hearts of all;
Richˈ were the sable robesˈ she wore—her white veilˈ round herˈ fell—
And from her neckˈ there hung the cross—the crossˈ she loved so well!
I knew that queenly form again, though blightedˈ was its bloom—
I sawˈ that griefˈ had decked it out—an offeringˈ for the tomb!
I knew the eye, though faint its light, that onceˈ so brightly shone—
I knew the voice, though feeble now, that thrilledˈ with every tone—
I knew the ringlets, almost grey, once threadsˈ of living gold—
I knew that bounding grace of step—that symmetry of mould!
Even nowˈ I see her far away, in that calmˈ convent aisle;
I hear her chant her vesper-hymn, I mark her holy smile—
Even nowˈ I see her bursting forth, upon her bridal morn,
A new starˈ in the firmament, to lightˈ and gloryˈ born!
Alas! the change! she placed her footˈ upon a triple throne,
Andˈ on the scaffoldˈ now she stands—beside the block, *alone!*
The little dogˈ that licks her hand, the last of all the crowdˈ
Who sunned themselvesˈ beneath her glance, and round her footsteps bowed!
Her neckˈ is bared—the blowˈ is struck—the soulˈ is passed away;
The bright—the beautiful—is nowˈ a bleeding piece of clay!
The dogˈ is moaning piteously; and, as it gurgles o'er,
Laps the warm bloodˈ that trickling runsˈ unheeded to the floor!
The blood of beauty, wealth, and power—the heart-blood of a *queen*,
The noblestˈ of the Stuart race—the fairestˈ earth hath seen—
Lapped by a dog! Go, think of it, in silenceˈ and alone;
Then weighˈ against a grain of sand, the glories of a throne!

H. G. BELL.

ELEGY WRITTEN IN A COUNTRY CHURCH-YARD.

[THOMAS GRAY, a celebrated English poet, was born in London in 1716, and died in 1771. His life was spent chiefly at the University of Cambridge, in which College he held the situation of Professor of modern history. As a poet he is energetic and full of classic grace, and his lyrics, though few, have been rarely, if ever, surpassed. His principal odes are "The Elegy Written in a Country Church-Yard," "The Progress of Poesy," and "The Ode on Eton College."]

THE curfew' tolls the knell of parting day,
The lowing herd' winds' slowly' o'er the lea,
The ploughman' homeward' plods his weary way,
And leaves the world' to darkness and to me.

Now' fades' the glimmering landscape' on the sight,
And all the air' a solemn stillness holds,
Save' where the beetle' wheels his droning flight,
And drowsy tinklings' lull the distant folds;

Save, that, from yonder ivy-mantled tower,
The moping owl' does to the moon complain
Of such as, wandering near her secret bower,
Molest her ancient' solitary reign.

Beneath those rugged elms, that yew-tree's shade,
Where heaves the turf' in many a mouldering heap,
Each' in his narrow cell' for ever laid,
The rude forefathers of the hamlet' sleep.

The breezy call' of incense-breathing morn,
The swallow' twittering from the straw-built shed,
The cock's shrill clarion, or the echoing horn,
No more' shall rouse them' from their lowly bed.

For them' no more the blazing hearth' shall burn,
Or busy housewife' ply her evening care;
No children run to lisp their sire's return,
Or climb his knees' the envied kiss' to share.

Oft' did the harvest' to their sickle yield,
Their furrow' oft' the stubborn glebe has broke;
How jocund' did they drive their team afield!
How' bowed the woods' beneath their sturdy stroke!

Let not ambition' mock their useful toil,
Their homely joys' and destiny obscure;
Nor grandeur' hear, with a disdainful smile,
The short' and simple annals of the poor.

The boast of heraldry, the pomp of power,
And all that beauty, all that wealth' e'er gave,
Await, alike, the inevitable hour:—
The paths of glory' lead—but to the grave.

Nor you, ye proud! impute to these the fault,
  If memoryˈ o'er their tombˈ no trophies raise,
Where, through the long-drawn aisleˈ and fretted vault,
  The pealing anthemˈ swells the note of praise.

Can storied urn, or animated bust,
  Back to its mansionˈ call the fleeting breath?
Can honour's voiceˈ provoke the silent dust,
  Or flatteryˈ soothe the dullˈ cold ear of death?

Perhapsˈ in this neglected spotˈ is laid
  Some heartˈ once pregnant with celestial fire;
Hands, that the rod of empire might have swayed,
  Or wakedˈ to ecstasyˈ the living lyre:

But Knowledgeˈ to their eyesˈ her ample page,
  Rich with the spoils of time, did ne'er unroll;
Chill penuryˈ repressed their noble rage,
  And froze the genial current of the soul.

Full many a gemˈ of purest ray serene
  The darkˈ unfathomed caves of oceanˈ bear;
Full many a flowerˈ is bornˈ to blush unseen,
  And waste its sweetnessˈ on the desert air.

Some village Hampden, that, with dauntless breast,
  The little tyrant of his fields withstood;
Some muteˈ inglorious Miltonˈ here may rest,
  Some Cromwell, guiltless of his country's blood.

The applause of listening senatesˈ to command,
  The threats of pain and ruinˈ to despise,
To scatter plentyˈ o'er a smiling land,
  And read their historyˈ in a nation's eyes.

Their lotˈ forbade: nor circumscribed alone
  Their growing virtues, but their crimes confined!—
Forbadeˈ to wadeˈ through slaughter to a throne,
  And shut the gates of mercyˈ on mankind;

The struggling pangs of conscious truthˈ to hide,
  To quench the blushes of ingenuous shame;
Or heap the shrine of luxury and prideˈ
  With incenseˈ kindled at the muse's flame.

Far from the madding crowd's ignoble strife—
  Their sober wishesˈ never learned to stray;
Along the coolˈ sequestered vale of lifeˈ
  They kept the noiseless tenor of their way.

Yet even these bones, from insult to protect,
  Some frail memorial, still erected nigh,
With uncouth rhymesˈ and shapeless sculptureˈ decked,
  Implores the passing tribute of a sigh.

Their name, their years, spelt by the unlettered muse,
  The place of fame and elegy supply:
And many a holy text around she strews,
  To teach the rustic moralistˈ to die.

For who, to dumb Forgetfulness' a prey,
This pleasing' anxious being e'er resigned,
Left the warm precincts of the cheerful day,
Nor cast one longing, lingering look behind?

On some fond breast' the parting soul relies,
Some pious drops' the closing eye requires;
Even from the tomb' the voice of Nature' cries,
Even in our ashes' live their wonted fires.

For thee, who, mindful of the unhonoured dead,
Dost' in these lines' their artless tale relate;
If, 'chance, by lonely contemplation led,
Some kindred spirit' shall inquire thy fate,

Haply' some hoary-headed swain' may say—
"Oft have we seen him, at the peep of dawn,
Brushing' with hasty steps' the dews away,
To meet the sun' upon the upland lawn.

"There, at the foot of yonder nodding beech,
That wreathes its old fantastic roots' so high,
His listless length' at noon-tide' would he stretch,
And pore upon the brook' that babbles by.

"Hard by yon wood, now smiling' as in scorn,
Muttering his wayward fancies' he would rove;
Now drooping, woeful, wan, like one forlorn,
Or crazed with care, or crossed in hopeless love.

"One morn' I missed him' on the accustomed hill,
Along the heath' and near his favourite tree;
Another' came; nor yet beside the rill,
Nor up the lawn, nor at the wood' was he:

"The next, with dirges due, in sad array,
Slow' through the church-way path we saw him borne:—
Approach, and read (for thou canst read) the lay
Graved on the stone' beneath yon aged thorn."

THE EPITAPH.

Here rests his head upon the lap of Earth,
A Youth, to Fortune' and to Fame' unknown:
Fair Science' frowned not on his humble birth,
And Melancholy' marked him for her own.

Large' was his bounty, and his soul' sincere;
Heaven' did a recompense' as largely send;
He gave to misery' all he had, a tear;
He gained from Heaven ('twas all he wished) a friend.

No further' seek his merits to disclose,
Or draw his frailties' from their dread abode,
(There' they alike' in trembling hope' repose)
The bosom of his Father' and his God.

GRAY.

PARADISE LOST—BOOK IV.

[JOHN MILTON, the most illustrious of England's epic poets, was the son of a scrivener in London, where he was born in 1608. He was educated at Christ's College, Cambridge, where he took his degree in Arts. From College he retired to his father's Villa in Buckinghamshire. Here he wrote his "Comus," "L'Allegro," "Il Penseroso," and "Lycidas," poems of such merit as would have alone immortalised his name. After travelling for a few months on the Continent, he returned and settled in London. The troubles breaking out between Charles I. and his Parliament, Milton engaged as a political writer on the popular side, and for twenty years the poet disappeared in the champion of liberty and religion. In 1652 he was wholly deprived of his sight, owing to intense application to his studies. His later years were employed in the composition of "Paradise Lost," the grandest work of his sublime genius, "Paradise Regained," "Samson Agonistes," &c. He died in 1674.]

O FOR that warning voice, which he who saw
The Apocalypse heard cry in Heaven aloud,
Then when the Dragon, put to second rout,
Came furious down to be revenged on men,
"Woe to the inhabitants on earth!" that now
While time was, our first parents had been warned
The coming of their sacred foe, and scaped,—
Haply so scaped his mortal snare! for now
Satan, now first inflamed with rage, came down,
The tempter, ere the accuser, of mankind,
To wreak on innocent frail man his loss
Of that first battle, and his flight to Hell:
Yet not rejoicing in his speed, though bold
Far off and fearless, nor with cause to boast,
Begins his dire attempt; which, nigh the birth
Now rolling, boils in his tumultuous breast,
And like a devilish engine back recoils
Upon himself: horror and doubt distract
His troubled thoughts, and from the bottom stir
The Hell within him; for within him Hell
He brings, and round about him, nor from Hell
One step, no more than from himself, can fly
By change of place: now conscience wakes despair
That slumbered; wakes the bitter memory
Of what he was, what is, and what must be,—
Worse; of worse deeds worse sufferings must ensue.
Sometimes towards Eden, which now in his view
Lay pleasant, his grieved look he fixes sad;
Sometimes towards Heaven and the full-blazing Sun,
Which now sat high in his meridian tower:
Then, much revolving, thus in sighs began:
"O thou, that, with surpassing glory crowned,
"Look'st from thy sole dominion like the god
"Of this new world! at whose sight all the stars
"Hide their diminished heads; to thee I call,
"But with no friendly voice, and add thy name,
"O Sun! to tell thee how I hate thy beams,
"That bring to my remembrance from what state

"I fell,—how glorious once above thy sphere,
"Till pride, and, worse, ambition threw me down,
"Warring in Heaven against Heaven's matchless King!
"Ah, wherefore! he deserved no such return
"From me, whom he created what I was
"In that bright eminence, and with his good
"Upbraided none; nor was his service hard.
"What could be less than to afford him praise,
"The easiest recompense, and pay him thanks,
"How due! Yet all his good proved ill in me,
"And wrought but malice: lifted up so high,
"I sdained subjection, and thought one step higher
"Would set me highest, and in a moment quit
"The debt immense of endless gratitude,—
"So burdensome; still paying, still to owe,—
"Forgetful what from him I still received;
"And understood not that a grateful mind
"By owing owes not, but still pays, at once
"Indebted and discharged: what burden then?
"O had his powerful destiny ordained
"Me some inferior angel, I had stood
"Then happy! no unbounded hope had raised
"Ambition. Yet why not? some other power
"As great might have aspired, and me, though mean,
"Drawn to his part; but other powers as great
"Fell not, but stand unshaken, from within
"Or from without, to all temptations armed.
"Hadst thou the same free will and power to stand?
"Thou hadst: whom hast thou then or what to accuse,
"But Heaven's free love dealt equally to all?
"Be then his love accursed! since, love or hate,
"To me alike it deals eternal woe.
"Nay, cursed be thou! since, against this, thy will
"Chose freely what it now so justly rues.
"Me miserable! which way shall I fly
"Infinite wrath, and infinite despair?
"Which way I fly is Hell; myself am Hell;
"And in the lowest deep a lower deep
"Still threatening to devour me opens wide,
"To which the Hell I suffer seems a Heaven.
"O, then, at last relent: is there no place
"Left for repentance? none for pardon left?
"None left but by submission; and that word
"Disdain forbids me, and my dread of shame
"Among the Spirits beneath; whom I seduced
"With other promises, and other vaunts
"Than to submit; boasting I could subdue
"The Omnipotent. Ah me! they little know
"How dearly I abide that boast so vain;
"Under what torments inwardly I groan,
"While they adore me on the throne of Hell.
"With diadem and sceptre high advanced,
"The lower still I fall, only supreme
"In misery: such joy ambition finds.
"But say I could repent, and could obtain,
"By act of grace, my former state; how soon

"Would height recall high thoughts, how soon unsay
"What feigned submission swore! Ease would recant
"Vows made in pain, as violent and void.
"For never can true reconcilement grow
"Where wounds of deadly hate have pierced so deep;
"Which would but lead me to a worse relapse
"And heavier fall: so should I purchase dear
"Short intermission, bought with double smart.
"This knows my Punisher; therefore as far
"From granting he, as I from begging peace.
"All hope excluded thus; behold, instead
"Of us outcast, exiled, his new delight,
"Mankind, created, and for him this world.
"So farewell, hope! and with hope, farewell, fear!
"Farewell, remorse! all good to me is lost:
"Evil, be thou my good! by thee at least
"Divided empire with Heaven's King I hold,—
"By thee, and more than half perhaps will reign;—
"As man ere long, and this new world, shall know."
  Thus while he spake, each passion dimmed his face
Thrice changed with pale, ire, envy, and despair;
Which marred his borrowed visage, and betrayed
Him counterfeit, if any eye beheld:
For heavenly minds from such distempers foul
Are ever clear. Whereof, he soon aware,
Each perturbation smoothed with outward calm.
Artificer of fraud; and was the first
That practised falsehood under saintly show,
Deep malice to conceal, couched with revenge.
Yet not enough had practised to deceive
Uriel once warned; whose eye pursued him down
The way he went, and on the Assyrian mount
Saw him disfigured, more than could befall
Spirit of happy sort: his gestures fierce
He marked, and mad demeanour, then alone,
As he supposed, all unobserved, unseen.
So on he fares, and to the border comes
Of Eden, where delicious Paradise,
Now nearer, crowns with her enclosure green,
As with a rural mound, the champain head
Of a steep wilderness, whose hairy sides
With thicket overgrown, grotesque and wild,
Access denied; and overhead up grew
Insuperable height of loftiest shade,—
Cedar, and pine, and fir, and branching palm,—
A sylvan scene; and, as the ranks ascend
Shade above shade, a woody theatre
Of stateliest view. Yet higher than their tops
The verdurous wall of Paradise up sprung;
Which to our general sire gave prospect large
Into his nether empire neighbouring round:
And higher than that wall a circling row
Of goodliest trees loaden with fairest fruit;
Blossoms and fruits at once, of golden hue,
Appeared, with gay enamelled colours mixed;
On which the sun more glad impressed his beams,

Than in fair evening cloud, or humid bow,
When God hath showered the earth; so lovely seemed
That landskip: and of pure now purer air
Meets his approach, and to the heart inspires
Vernal delight and joy, able to drive
All sadness but despair: now gentle gales,
Fanning their odoriferous wings, dispense
Native perfumes, and whisper whence they stole
Those balmy spoils. As when to them who sail
Beyond the Cape of Hope, and now are past
Mozambic, off at sea north-east winds blow
Sabëan odours from the spicy shores
Of Araby the Blest; with such delay
Well pleased they slack their course, and, many a league,
Cheered with the grateful smell old Ocean smiles:
So entertained those odorous sweets the fiend
Who came their bane; though with them better pleased
Than Asmodëus with the fishy fume
That drove him, though enamoured, from the spouse
Of Tobit's son, and with a vengeance sent
From Media post to Egypt, there fast bound.
Now to the ascent of that steep savage hill
Satan had journeyed on, pensive and slow;
But further way found none; so thick entwined,
As one continued brake, the undergrowth
Of shrubs and tangling bushes had perplexed
All path of man or beast that passed that way.
One gate there only was, and that looked east
On the other side: which when the arch-felon saw,
Due entrance he disdained; and, in contempt,
At one slight bound high overleaped all bound
Of hill or highest wall, and sheer within
Lights on his feet. As when a prowling wolf,
Whom hunger drives to seek new haunt for prey,
Watching where shepherds pen their flocks at eve
In hurdled cotes, amid the field secure,
Leaps o'er the fence with ease into the fold
Or as a thief, bent to unhoard the cash
Of some rich burgher, whose substantial doors,
Cross barred and bolted fast, fear no assault,
In at the window climbs, or o'er the tiles;
So clomb this first grand thief into God's fold;
So since into his church lewd hirelings climb.
Thence up he flew; and on the Tree of Life,
(The middle tree and highest there that grew,)
Sat like a cormorant: yet not true life
Thereby regained, but sat devising death
To them who lived; nor on the virtue thought
Of that life-giving plant, but only used
For prospect, what, well used, had been the pledge
Of immortality. So little knows
Any, but God alone, to value right
The good before him; but perverts best things
To worst abuse, or to their meanest use.
Beneath him, with new wonder, now he views,
To all delight of human sense exposed,

In narrow room, Nature's whole wealth, yea, more,
A Heaven on Earth; for blissful Paradise
Of God the garden was, by him in the east
Of Eden planted: Eden stretched her line
From Auran eastward to the royal towers
Of great Seleucia, built by Grecian kings,
Or where the sons of Eden long before
Dwelt in Telassar: in this pleasant soil
His far more pleasant garden God ordained.
Out of the fertile ground he caused to grow
All trees of noblest kind for sight, smell, taste;
And all amid them stood the Tree of Life,
High eminent, blooming ambrosial fruit
Of vegetable gold; and next to life,
Our death, the Tree of Knowledge, grew fast by,—
Knowledge of good, bought dear, by knowing ill.
Southward through Eden went a river large,
Nor changed his course, but through the shaggy hill
Passed underneath ingulfed; for God had thrown
That mountain as his garden mould, high raised
Upon the rapid current, which, through veins
Of porous earth with kindly thirst up drawn,
Rose a fresh fountain, and with many a rill
Watered the garden; thence united fell
Down the steep glade, and met the nether flood,
Which from his darksome passage now appears;
And now, divided into four main streams,
Runs diverse, wandering many a famous realm
And country, whereof here needs no account;
But rather to tell how—if art could tell—
How from that sapphire fount the crisped brooks,
Rolling on orient pearl and sands of gold,
With mazy error under pendent shades
Ran nectar, visiting each plant, and fed
Flowers worthy of Paradise; which not nice art
In beds and curious knots, but nature boon
Poured forth profuse on hill, and dale, and plain;
Both where the morning sun first warmly smote
The open field, and where the unpiercèd shade
Imbrowned the noontide bowers. Thus was this place
A happy rural seat of various view;
Groves whose rich trees wept odorous gums and balm;
Others, whose fruit, burnished with golden rind,
Hung amiable, (Hesperian fables true,
If true, here only,) and of delicious taste.
Betwixt them lawns, or level downs, and flocks
Grazing the tender herb, were interposed;
Or palmy hillock, or the flowery lap
Of some irriguous valley spread her stores,—
Flowers of all hue, and without thorn the rose.
Another side, umbrageous grots and caves
Of cool recess, o'er which the mantling vine
Lays forth her purple grape, and gently creeps
Luxuriant: meanwhile murmuring waters fall
Down the slope hills, dispersed; or in a lake,
That to the fringed bank with myrtle crowned

Her crystal mirror holds, unite their streams.
The birds their quire apply; airs,—vernal airs,
Breathing the smell of field and grove, attune
The trembling leaves, while universal Pan,
Knit with the Graces and the Hours in dance,
Led on the eternal spring. Not that fair field
Of Enna, where Prosérpine gathering flowers,
Herself a fairer flower, by gloomy Dis
Was gathered, which cost Ceres all that pain
To seek her through the world; nor that sweet grove
Of Daphne by Orontes, and the inspired
Castalian spring, might with this Paradise
Of Eden strive; nor that Nyseian isle
Girt with the river Triton, where old Cham,
(Whom Gentiles Ammon call and Libyan Jove),
Hid Amalthëa, and her florid son,
Young Bacchus, from his stepdame Rhëa's eye;
Nor where Abassin kings their issue guard,
Mount Amara, (though this by some supposed
True Paradise,) under the Ethiop line
By Nilus' head, inclosed with shining rock,
A whole day's journey high, but wide remote
From this Assyrian garden, where the fiend
Saw, undelighted, all delight,—all kind
Of living creatures, new to sight and strange.
Two of far nobler shape, erect and tall,—
Godlike erect, with native honour clad
In naked majesty, seemed lords of all:
And worthy seemed; for in their looks divine
The image of their glorious Maker shone,
Truth, wisdom, sanctitude severe and pure,—
Severe, but in true filial freedom placed;
Whence true authority in men: though both
Not equal, as their sex not equal, seemed;
For contemplation he and valour formed,
For softness she and sweet attractive grace;
He, for God only; she, for God in him.
His fair large front and eye sublime declared
Absolute rule; and hyacinthine locks
Round from his parted forelock manly hung
Clustering, but not beneath his shoulders broad:
She, as a veil, down to the slender waist
Her unadorned golden tresses wore
Dishevelled, but in wanton ringlets waved
As the vine curls her tendrils; which implied
Subjection, but required with gentle sway,
And by her yielded,—by him best received,
Yielded with coy submission, modest pride,
And sweet, reluctant, amorous delay.
Nor those mysterious parts were then concealed;
Then was not guilty shame: dishonest shame
Of Nature's works,—honour dishonourable,
Sin-bred! how have ye troubled all mankind
With shows instead, mere shows of seeming pure,
And banished from man's life his happiest life,
Simplicity and spotless innocence!

So passed they naked on, nor shunned the sight
Of God or angel, for they thought no ill:
So hand in hand they passed, the loveliest pair
That ever since in love's embraces met;
Adam the goodliest man of men since born
His sons, the fairest of her daughters Eve.
Under a tuft of shade, that on a green
Stood whispering soft, by a fresh fountain-side
They sat them down; and, after no more toil
Of their sweet gardening labour than sufficed
To recommend cool zephyr, and made ease
More easy, wholesome thirst and appetite
More grateful, to their supper-fruits they fell—
Nectarine fruits, which the compliant boughs
Yielded them, sidelong as they sat recline
On the soft downy bank damasked with flowers.
The savoury pulp they chew, and in the rind,
Still as they thirsted, scoop the brimming stream:
Nor gentle purpose, nor endearing smiles
Wanted, nor youthful dalliance, as beseems
Fair couple, linked in happy nuptial league,
Alone as they. About them frisking played
All beasts of the earth, since wild, and of all chase
In wood or wilderness, forest or den:
Sporting the lion ramped, and in his paw
Dandled the kid: bears, tigers, ounces, pards,
Gambolled before them; the unwieldy elephant,
To make them mirth, used all his might, and wreathed
His lithe proboscis: close the serpent sly,
Insinuating, wove with Gordian twine
His braided train, and of his fatal guile
Gave proof unheeded: others on the grass
Couched, and, now filled with pasture, gazing sat,
Or bedward ruminating; for the Sun,
Declined, was hasting now with prone career
To the ocean isles, and in the ascending scale
Of Heaven the stars that usher evening rose:
When Satan, still in gaze, as first he stood,
Scarce thus at length failed speech recovered said:
"O Hell! what do mine eyes with grief behold?
"Into our room of bliss thus high advanced
"Creatures of other mould, earth-born perhaps,
"Not spirits; yet to heavenly spirits bright
"Little inferior; whom my thoughts pursue
"With wonder, and could love; so lively shines
"In them divine resemblance, and such grace
"The hand that formed them on their shape hath poured!
"Ah, gentle pair! ye little think how nigh
"Your change approaches, when all these delights
"Will vanish, and deliver ye to woe;—
"More woe, the more your taste is now of joy!
"Happy, but for so happy ill secured
"Long to continue; and this high seat, your Heaven,
"Ill fenced for Heaven to keep out such a foe
"As now is entered! yet no purposed foe
"To you, whom I could pity thus forlorn,

"Though I unpitied. League with you I seek,
"And mutual amity, so strait, so close,
"That I with you must dwell, or you with me,
"Henceforth: my dwelling haply may not please,
"Like this fair Paradise, your sense; yet such
"Accept, your Maker's work; he gave it me,
"Which I as freely give: Hell shall unfold,
"To entertain you two, her widest gates,
"And send forth all her kings: there will be room,
"Not like these narrow limits, to receive
"Your numerous offspring; if no better place,
"Thank him who puts me loth to this revenge
"On you, who wrong me not, for him who wronged.
"And should I at your harmless innocence
"Melt, as I do, yet public reason just,
"Honour and empire, with revenge, enlarged,
"By conquering this new world, compels me now
"To do what else, though damned, I should abhor."
So spake the fiend, and with necessity,
The tyrant's plea, excused his devilish deeds.
Then, from his lofty stand on that high tree,
Down he alights among the sportful herd
Of those four-footed kinds—himself now one,
Now other, as their shape served best his end—
Nearer to view his prey, and, unespied,
To mark what of their state he more might learn,
By word or action marked: about them round,
A lion now, he stalks with fiery glare;
Then, as a tiger, who by chance hath spied
In some purlieu two gentle fawns at play,
Straight couches close; then, rising, changes oft
His couchant watch, as one who chose his ground,
Whence rushing he might surest seize them both,
Griped in each paw: when Adam, first of men,
To first of women, Eve, thus moving speech,
Turned him, all ear, to hear new utterance flow:
"Sole partner, and sole part, of all these joys,
"Dearer thyself than all! needs must the Power
"That made us, and for us this ample world,
"Be infinitely good, and of his good
"As liberal and free as infinite;
"That raised us from the dust, and placed us here
"In all this happiness, who at his hand
"Have nothing merited, nor can perform
"Aught whereof he hath need; he who requires
"From us no other service than to keep
"This one—this easy charge: of all the trees
"In Paradise that bear delicious fruit
"So various, not to taste that only Tree
"Of Knowledge, planted by the Tree of Life:
"So near grows death to life! whate'er death is;
"Some dreadful thing no doubt: for well thou know'st
"God hath pronounced it death to taste that tree;
"The only sign of our obedience left
"Among so many signs of power and rule
"Conferred upon us, and dominion given

"Over all other creatures that possess
"Earth, air, and sea. Then, let us not think hard
"One easy prohibition, who enjoy
"Free leave so large to all things else, and choice
"Unlimited of manifold delights:
"But let us ever praise him, and extol
"His bounty, following our delightful task
"To prune these growing plants, and tend these flowers;
"Which, were it toilsome, yet with thee were sweet."
To whom thus Eve replied: "O thou, for whom,
"And from whom I was formed, flesh of thy flesh;
"And without whom am to no end; my guide
"And head! what thou hast said is just and right.
"For we to him indeed all praises owe,
"And daily thanks: I chiefly, who enjoy
"So far the happier lot, enjoying thee,
"Pre-eminent by so much odds, while thou
"Like consort to thyself canst nowhere find.
"That day I oft remember, when from sleep
"I first awaked, and found myself reposed,
"Under a shade, on flowers; much wondering where
"And what I was, whence thither brought, and how.
"Not distant far from thence a murmuring sound
"Of waters issued from a cave, and spread
"Into a liquid plain; then stood unmoved,
"Pure as the expanse of Heaven: I thither went
"With unexperienced thought, and laid me down
"On the green bank, to look into the clear
"Smooth lake, that to me seemed another sky.
"As I bent down to look, just opposite
"A shape within the watery gleam appeared,
"Bending to look on me: I started back:
"It started back: but pleased I soon returned:
"Pleased it returned as soon with answering looks
"Of sympathy and love: there I had fixed
"Mine eyes till now, and pined with vain desire,
"Had not a voice thus warned me: 'What thou seest,
"What there thou seest, fair creature, is thyself;
"With thee it came and goes: but follow me,
"And I will bring thee where no shadow stays
"Thy coming, and thy soft embraces;—he
"Whose image thou art: him thou shalt enjoy
"Inseparably thine; to him shalt bear
"Multitudes like thyself, and thence be called
"Mother of human race.' What could I do,
"But follow straight, invisibly thus led?
"Till I espied thee, fair indeed, and tall,
"Under a platane; yet, methought, less fair,
"Less winning soft, less amiably mild,
"Than that smooth watery image. Back I turned:
"Thou following criedst aloud, 'Return, fair Eve!
"Whom fliest thou? whom thou fliest, of him thou art,
"His flesh, his bone; to give thee being I lent
"Out of my side to thee, nearest my heart,
"Substantial life; to have thee by my side
"Henceforth an individual solace dear:

"Part of my soul, I seek thee, and thee claim,
"My other half!' With that thy gentle hand
"Seized mine: I yielded; and from that time see
"How beauty is excelled by manly grace
"And wisdom, which alone is truly fair."
So spake our general mother; and, with eyes
Of conjugal attraction unreproved,
And meek surrender, half-embracing leaned
On our first father; half her swelling breast
Naked met his, under the flowing gold
Of her loose tresses hid: he, in delight
Both of her beauty and submissive charms,
Smiled with superior love, as Jupiter
On Juno smiles, when he impregns the clouds
That shed May flowers; and pressed her matron lip
With kisses pure. Aside the devil turned
For envy; yet with jealous leer malign
Eyed them askance, and to himself thus plained:
"Sight hateful, sight tormenting! thus these two,
"Imparadised in one another's arms,
"(The happier Eden!) shall enjoy their fill
"Of bliss on bliss; while I to hell am thrust,
"Where neither joy nor love, but fierce desire,
"Among our other torments not the least,
"Still unfulfilled, with pain of longing pines.
"Yet let me not forget what I have gained
"From their own mouths: all is not theirs, it seems:
"One fatal tree there stands, of Knowledge called,
"Forbidden them to taste: knowledge forbidden!
"Suspicious, reasonless. Why should their Lord
"Envy them that? Can it be sin to know?
"Can it be death? And do they only stand
"By ignorance? Is that their happy state,
"The proof of their obedience and their faith?
"O fair foundation laid whereon to build
"Their ruin! Hence I will excite their minds
"With more desire to know, and to reject
"Envious commands, invented with design
"To keep them low, whom knowledge might exalt
"Equal with gods: aspiring to be such,
"They taste, and die! what likelier can ensue?
"But first, with narrow search, I must walk round
"This garden, and no corner leave unspied;
"A chance but chance may lead where I may meet
"Some wandering spirit of Heaven, by fountain side,
"Or in thick shade retired, from him to draw
"What farther would be learned. Live while ye may,
"Yet happy pair! enjoy, till I return,
"Short pleasures; for long woes are to succeed."
So saying, his proud step he scornful turned,
But with sly circumspection, and began
Through wood, through waste, o'er hill, o'er dale, his roam.
Meanwhile, in utmost longitude, where Heaven
With Earth and Ocean meets, the setting sun
Slowly descended, and, with right aspéct
Against the eastern gate of Paradise

Levelled his evening rays: it was a rock
Of alabaster, piled up to the clouds,
Conspicuous far, winding with one ascent
Accessible from earth, one entrance high;
The rest was craggy cliff, that overhung
Still as it rose, impossible to climb.
Betwixt these rocky pillars Gabriel sat,
Chief of the angelic guards, awaiting night;
About him exercised heroic games
The unarmèd youth of Heaven; but nigh at hand
Celestial armoury, shields, helms, and spears,
Hung high, with diamond flaming, and with gold.
Thither came Uriel, gliding through the even
On a sunbéam, swift as a shooting star
In autumn thwarts the night, when vapours fired
Impress the air, and show the mariner
From what point of his compass to beware
Impetuous winds: he thus began in haste:
"Gabriel! to thee thy course by lot hath given
"Charge and strict watch, that to this happy place
"No evil thing approach, or enter in.
"This day, at height of noon, came to my sphere
"A spirit, zealous, as he seemed, to know
"More of the Almighty's works, and chiefly man,
"God's latest image; I described his way,
"Bent all on speed, and marked his airy gait;
"But, in the mount that lies from Eden north,
"Where he first lighted, soon discerned his looks
"Alien from Heaven, with passions foul obscured:
"Mine eye pursued him still, but under shade
"Lost sight of him. One of the banished crew,
"I fear, hath ventured from the deep, to raise
"New troubles: him thy care must be to find."
To whom the wingèd warrior thus returned:
"Uriel! no wonder if thy perfect sight,
"Amid the sun's bright circle where thou sitt'st,
"See far and wide: in at this gate none pass
"The vigilance here placed, but such as come
"Well known from Heaven; and since meridian hour
"No creature thence. If spirit of other sort,
"So minded, have o'erleaped these earthly bounds
"On purpose, hard thou know'st it to exclude
"Spiritual substance with corporeal bar.
"But if within the circuit of these walks
"In whatsoever shape he lurk, of whom
"Thou tell'st, by morrow dawning I shall know."
So promised he; and Urïel to his charge
Returned on that bright beam, whose point now raised
Bore him slope downwards to the Sun, now fallen
Beneath the Azorès; whether the prime orb,
Incredible how swift, had thither rolled
Diurnal; or this less volúbil Earth,
By shorter flight to the east, had left him there,
Arraying with reflected purple and gold
The clouds that on his western throne attend.
Now came still evening on, and twilight gray

Had in her sober livery all things clad:
Silence accompanied; for beast and bird,
They to their grassy couch, these to their nests,
Were slunk;—all but the wakeful nightingale;
She all night long her amorous descant sung;
Silence was pleased: now glowed the firmament
With living sapphires: Hesperus, that led
The starry host, rode brightest, till the Moon,
Rising in clouded majesty, at length,
Apparent queen, unveiled her peerless light,
And o'er the dark her silver mantle threw.
  When Adam thus to Eve: "Fair consort! the hour
"Of night, and all things now retired to rest,
"Mind us of like repose; since God hath set
"Labour and rest, as day and night, to men
"Successive; and the timely dew of sleep,
"Now falling with soft slumberous weight, inclines
"Our eyelids: other creatures all day long
"Rove idle, unemployed, and less need rest:
"Man hath his daily work of body or mind
"Appointed, which declares his dignity,
"And the regard of Heaven on all his ways;
"While other animals inactive range,
"And of their doings God takes no account.
"To-morrow, ere fresh morning streak the east
"With first approach of light, we must be risen,
"And at our pleasant labour, to reform
"Yon flowery arbours, yonder alleys green,
"Our walk at noon, with branches overgrown,
"That mock our scant manuring, and require
"More hands than ours to lop their wanton growth:
"Those blossoms also, and those drooping gums,
"That lie bestrown, unsightly and unsmooth,
"Ask riddance, if we mean to tread with ease;
"Meanwhile, as Nature wills, night bids us rest."
  To whom thus Eve, with perfect beauty adorned:
"My author and disposer! what thou bidst
"Unargued I obey: so God ordains.
"God is thy law, thou mine: to know no more
"Is woman's happiest knowledge, and her praise.
"With thee conversing I forget all time;
"All seasons, and their change,—all please alike.
"Sweet is the breath of morn, her rising sweet,
"With charm of earliest birds; pleasant the Sun,
"When first on this delightful land he spreads
"His orient beams, on herb, tree, fruit, and flower,
"Glistering with dew; fragrant the fertile Earth
"After soft showers; and sweet the coming on
"Of grateful Evening mild; then silent Night,
"With this her solemn bird, and this fair Moon,
"And these the gems of Heaven, her starry train.
"But neither breath of Morn, when she ascends
"With charm of earliest birds; nor rising Sun
"On this delightful land; nor herb, fruit, flower,
"Glistering with dew; nor fragrance after showers;
"Nor grateful Evening mild; nor silent Night,

"With this her solemn bird; nor walk by Moon,
"Or glittering starlight, without thee is sweet.
"But wherefore all night long shine these? for whom?
"This glorious sight, when sleep hath shut all eyes?"
To whom our general ancestor replied:
"Daughter of God and Man, accomplished Eve,
"Those have their course to finish, round the Earth,
"By morrow evening; and from land to land
"In order, though to nations yet unborn,
"Ministering light prepared, they set and rise;
"Lest total Darkness should by night regain
"Her old possession, and extinguish life
"In Nature and all things; which these soft fires
"Not only enlighten, but, with kindly heat
"Of various influence, foment and warm,
"Temper or nourish; or in part shed down
"Their stellar virtue on all kinds that grow
"On earth, made hereby apter to receive
"Perfection from the sun's more potent ray.
"These then, though unbeheld in deep of night,
"Shine not in vain; nor think, though men were none,
"That Heaven would want spectators, God want praise:
"Millions of spiritual creatures walk the earth
"Unseen, both when we wake, and when we sleep;
"All these, with ceaseless praise, his works behold
"Both day and night. How often from the steep
"Of echoing hill or thicket have we heard
"Celestial voices, to the midnight air
"(Sole, or responsive each to other's note,)
"Singing their great Creator! Oft in bands
"While they keep watch, or nightly rounding walk,
"With heavenly touch of instrumental sounds,
"In full harmonic number joined their songs
"Divide the night, and lift our thoughts to Heaven."
Thus talking, hand in hand alone they passed
On to their blissful bower: it was a place
Chosen by the sovereign Planter, when he framed
All things to Man's delightful use: the roof,
Of thickest covert, was inwoven shade,
Laurel and myrtle, and what higher grew
Of firm and fragrant leaf: on either side
Acanthus, and each odorous bushy shrub,
Fenced up the verdant wall: each beauteous flower,
Iris all hues, roses, and jessamine,
Reared high their flourished heads between, and wrought
Mosaic: under foot the violet,
Crocus, and hyacinth, with rich inlay
'Broidered the ground, more coloured than with stone
Of costliest emblem: other creature here,
Bird, beast, insect, or worm, durst enter none;
Such was their awe of man. In shadier bower,
More sacred and sequestered, though but feigned,
Pan or Sylvanus never slept; nor Nymph
Nor Faunus haunted. Here, in close recess,
With flowers, garlands, and sweet-smelling herbs,
Espousèd Eve decked first her nuptial bed;

And heavenly quires the hymenean sung,
What day the genial angel to our sire
Brought her, in naked beauty more adorned,
More lovely, than Pandora, whom the gods
Endowed with all their gifts;—and, O too like
In sad event,—when, to the unwiser son
Of Japhet brought by Hermes, she ensnared
Mankind with her fair looks, to be avenged
On him who had stole Jove's authentic fire.
   Thus, at their shady lodge arrived, both stood,
Both turned, and under open sky adored
The God that made both sky, air, earth, and Heaven,
Which they beheld, the moon's resplendent globe,
And starry pole: "Thou also madest the night,
"Maker Omnipotent, and thou the day,
"Which we, in our appointed work employed,
"Have finished, happy in our mutual help
"And mutual love,—the crown of all our bliss
"Ordained by thee,—and this delicious place,
"For us too large, where thy abundance wants
"Partakers, and uncropt falls to the ground.
"But thou hast promised from us two a race
"To fill the earth, who shall with us extol
"Thy goodness infinite, both when we wake,
"And when we seek, as now, thy gift of sleep."

PREFIXES.

English or Saxon.

A, *on* or *in*, as *a*bed, *a*shore.
Be, *about* or *before*, as *be*spatter.
En, em or im, *in* or *on*, also *to make*, as *en*circle, *em*bark, *im*bibe, *en*feeble.
Fore, *before*, *fore*tell.
Mis, *error*, *mis*deed.
Out, *beyond* or *superiority*, *out*run.
Over, *eminence* or *excess*, *over*top, *over*throw.
Un, *not*; before a verb, *to undo*, *un*pleasant, *un*tie.
Up, *motion upwards*, as *up*right.
With, *from* or *against*, *with*hold, *with*stand.

Latin.

A, ab, abs, *from* or *away*, as avert, *ab*hor, *abs*tain.
Ad, with its different forms, a, ac, af, ag, al, an, ap, ar, as, at, *to*, as *ad*here, *a*scend, *ac*cept, *af*fect, *ag*gravate, *al*lot, *an*nounce, *ap*pear, *ar*rest, *as*sent, *at*tend.
Am, *round about*, *am*bient.
Ante, *before*, *ante*cedent.
Circum, with its form circu, *round about*, *circum*ference, *circu*it.
Cis, *on this side*, *cis*alpine.
Con, with its various forms, co, cog, col, com, cor, *together*, as *con*vene, *co*-operate, *cog*nate, *col*lect, *com*pose, *cor*rect.
Contra, which has sometimes the form counter, *against*, *contra*dict, *counter*act.
De, *down*, as *de*ject.
Dis, with its forms, di, dif, *asunder*, as *dis*sever, *di*vert, *dif*fuse.
E, ex, with its forms, ec, ef, *out of*, *from*, as *e*ject, *ex*pel, *ec*centric, *ef*fuse.
Extra, *beyond*, *extra*vagant.
In, with its forms, ig, il, im, ir, *in*, *into*, *upon*, as *in*ter, *ig*gnite, *il*lumine, *im*pend, *ir*rigate; before adjectives it means *not*, as *in*active, *ig*norant.
Inter, *between*, *inter*cept.
Intro, *within*, *intro*duce.
Juxta, *close to*, *juxta*position.
Ob, with its various forms, oc, of, op, *in the way of*, *against*, *ob*stacle, *oc*cur, *of*fer, *op*pose.
Per or pel, *through*, *thoroughly*, *per*fect, *pel*lucid.
Post, *after*, *post*script.
Pre, *before*, *pre*cede.
Preter, *beyond*, *preter*natural.
Pro, *forth*, *for*, *forward*, *pro*voke, *pro*noun, *pro*ceed.
Re, *back* or *again*, *re*cede, *re*peat.
Retro, *backwards*, *retro*spect.
Se, *aside* or *apart*, *se*cede.
Sine, with its forms, sim and sin, *without*, *sine*cure, *sim*ple, *sin*cere.
Sub, with its forms, suc, suf, sug, sup, sus, *under* or *after*, as *sub*ject, *suc*ceed, *suf*fuse, *sug*gest, *sup*pose, *sus*tain.
Subter, *under*, as *subter*fuge.
Super, or sur, *over* or *above*, *super*fine, *sur*prise.
Trans, *across*, *beyond*, *trans*fer.
Ultra, *beyond*, *ultra*marine.

Greek.

A, or an, *without*, *a*pathy, *an*archy.
Amphi, *both*, *amphi*bious.
Ana, *through* or *up*, *ana*tomy.
Anti, *against*, *anti*christ.
Apo, *from*, *apo*stasy.
Cata, *down*, *cata*rrh.
Dia, *through*, *dia*meter.
Endo, *within*, *endo*genous.
Epi, *upon*, *epi*taph.
Exo, or ex, *without*, *exo*tic.
Hyper, *over and above*, *hyper*critical.
Hypo, *under*, *hypo*crite.
Meta, *change*, *meta*morphosis.
Para, *beside*, *near to*, *para*llel, *par*ody.
Peri, *round*, *peri*phrasis.
Syn, with its forms, sy, syl, sym, *together*, *syn*tax, *sy*stem, *syl*logism, *sym*pathy.

AFFIXES.

I. Denoting the *agent* or *doer* of a thing.
An, as guardi*an*.
Ant, as assist*ant*.
Ar, as li*ar*.
Ard, as drunk*ard*.
Ary, as secret*ary*.
Eer, as mulet*eer*.
Ent, as stud*ent*.
Er, as mak*er*.
Ist, as athe*ist*.
Ive, as representat*ive*.
Or, as fact*or*.
Ster, as pun*ster*.

II. The *person acted upon*.
Ee, as trust*ee*.
Ite, as favour*ite*.
Ive, as capt*ive*.

III. *Being* or *state of being*.
Age, as parent*age*.
Ance, as ignor*ance*; or
Ancy, as occup*ancy*.
Ence, as consist*ence*; or
Ency, as tend*ency*.
Hood, as child*hood*.
Ism, as hero*ism*.
Ment, as treat*ment*.
Mony, as sancti*mony*.
Ness, as kind*ness*.
Ry, as slave*ry*.
Ship, as hard*ship*.
Sion, as exten*sion*.
Th, as heal*th*.
Tion, as mo*tion*.
Try, as gallan*try*.
Tude, as soli*tude*.
Ty, as pover*ty*.
Ure, as ten*ure*.
Y, as villan*y*.

IV. *Diminutives*.
Cle, as parti*cle*.
Kin, as lamb*kin*.
Let, as stream*let*.
Ling, as duck*ling*.
Ock, as hill*ock*.

V. *Of* or *belonging to*.
Al, as crimin*al*.
An, as sylv*an*.
Ar, as globul*ar*.
Ary, as station*ary*.
En, as gold*en*.
Ic, as angel*ic*.
Ile, as infant*ile*.
Ine, as mar*ine*.
Ish, as self*ish*.
Ory, as olfact*ory*.

VI. *Full of*.
Ate, as passion*ate*.
Ful, as joy*ful*.
Ose, as joc*ose*.
Ous, as nerv*ous*.
Some, as play*some*.
Y, as health*y*.

VII. *Like*.
Ish, as child*ish*.
Like, as war*like*.
Ly, as friend*ly*.

VIII. *That may be*.
Able, as port*able*.
Ible, as poss*ible*.

IX. *Without*.
Less, as worth*less*.

X. *To make*.
Ate, as regul*ate*.
En, as hard*en*.
Fy, as puri*fy*.
Ish, as fin*ish*.
Ise, as colon*ise*.
Ize, equal*ize*.

XI. *Jurisdiction*.
Dom, as king*dom*.
Ric, as bishop*ric*.

SAXON ROOTS WITH DERIVATIVES.

Ac, an oak; *acorn*.
Beatan, to beat; *batter, beetle*.
Bellan, to bellow; *bawl*.
Beorgan, to protect; *burg, borough*.
Betan, to improve; *better*.
Bidan, to wait; *bide, abode*.
Biddan, to pray; *bead, beadle*.
Bindan, to bind; *bind, bond*.
Bitan, to bite; *bitter*.
Blac, pale; *bleach*.
Blawan, to blow; *blast, bluster*.
Blowan, to blow as a flower; *bloom*.

Boc, a book; *book, beech.*
Bodig, stature; *body.*
Brad, broad; *broad.*
Brecan, to break; *breach, brake.*
Bredan, to nourish; *bread.*
Bredan, to weave; *braid.*
Brytan, to break; *brittle.*
Buan, to cultivate; *boor.*
Bugan, to bend; *bough, elbow.*
Burne, a stream; *bourn.*
Byrnan, to burn; *burnish, brimstone.*
Ceapian, to buy; *cheap, chapman.*
Ceorl, a countryman; *churl, carlin.*
Clufan, to cleave; *cliff, clover.*
Cnafa, a boy; *knave.*
Cnawan, to know; *acknowledge.*
Cnyttan, to knit; *knot.*
Cryc, a staff; *crook.*
Cunnan, to know; *ken.*
Cwethan, to speak; *quoth.*
Cwysan, to crush; *quash, squeeze.*
Cyn, kin; *kindred.*
Daeg, a day; *dawn, daisy.*
Deman, to judge; *deem.*
Deore, precious; *dear, darling.*
Dragan, to draw; *drag, drudge.*
Drygan, to dry; *drought, drug.*
Drypan, to drip; *drop, droop.*
Dun, a hill; *downs, Dundee.*
Duru, a passage; *door, through.*
Dweorh, bent; *dwarf.*
Dwinan, to fade; *dwindle, dwine.*
Dyppan, to dip; *dip, dive.*
Erian, to plough; *ear earth.*
Faest, firm; *fast, fasten.*
Faran, to go; *fare, ford.*
Fedan, to feed; *food, father.*
Feoh, value, cattle; *fee.*
Fian, to hate; *fiend, foe, feud.*
Fleon, to flee; *fly, flutter.*
Flowan, to flow; *float, flood, fleet.*
Fot, the foot; *feet, fetter.*
Freon, to love, to free; *friend, freedom.*
Fulian, to corrupt; *foul, filth.*
Gabban, to scoff; *jibe, gabble.*
Gangan, to go; *gang, gangway.*
Geap, wide; *gap, gape.*
Geard, enclosure; *yard, garden.*
Georn, anxious; *yearn, earnest.*
God, good; *God, gospel.*
Grafan, to dig; *grave, grove.*
Habban, to have; *behave, hap.*
Haelan, to heal; *health, holy.*
Healdan, to hold; *behold, hilt.*
Hefan, to lift; *heave, heaven.*
Hyran, to hear; *hire, rehearsal.*
Hund, a dog; *hound.*
Lædan, to lead; *ladder, loadstone.*
Læne, frail; *lean.*
Læt, late; *last, lazy.*
Lecgan, to lay; *law, layer.*
Leod, a countryman; *lad.*
Magan, to be able; *may, main.*
Mearc, a mark; *remark, marches.*
Mengan, to mix; *mingle monarel.*
Mona, the moon; *month Monday.*
Neah, nigh; *near, neighbour.*
Oga, dread; *ugly.*
Pycan, to pick; *picket, peck.*
Ranc, proud; *rank, rankle.*
Reafian, to rob; *bereave, rover.*
Ricé, power; *rich, enrich.*
Ridan, to ride; *road, roadstead.*
Ripan, to reap; *reaper, ripen.*
Sceadan, to shade; *shadow, shed.*
Sceapan, to form; *shape, shop.*
Sceotan, to shoot; *shot, shut, sheet.*
Sceran, to cut; *shear, scar, shire.*
Scridan, to clothe; *shroud.*
Scufan, to thrust; *scuffle, shovel.*
Seoc, sick; *sigh.*
Sean, to see; *sight, seer.*
Settan, to set; *settle, seat, sad.*
Slagan or slean, to kill; *slay, sly.*
Slawan, to be slow; *slow, sloth.*
Spell, history, message; *spell, gospel.*
Spinnan, to spin; *spider, spindle.*
Snican, to creep; *snake, sneak.*
Spor, a heel; *spur, spurn.*
Steorfan, to die; *starve.*
Stepan, to raise; *steep, step.*
Stigan, to ascend; *stage, stairs.*
Styran, to steer; *stern, starboard.*
Swam, a mushroom; *swamp.*
Swifan, to turn round; *swivel, swift.*
Tellan, to tell; *tale, told.*
Thincan, to seem; *methinks.*
Treow, true; *betroth, truth.*
Twa, two; *twain, twin, betwixt.*
Wanian, to fail; *wane, wan, want.*
Weard, guard; *ward, warden.*
Wed, a pledge; *wed, wedlock.*
Wefan, to weave; *weft, web, wife.*
Weg, a way; *wain, waggon.*
Wenden, to go; *wend, went, wander.*
Weod, clothing; *weed, widow's-weeds.*
Weor, bad (conp. wyrse); *worse.*

Weorth, worth; *worthy*, *worship*.
Wind, the wind; *winnow*, *winter*.
Witan or wissan, to know; *wit*, *wise*, *wizard*.
Wringan, to wring; *wring*, *wrangle*.
Writhan, to bind; *writhe*, *wreath*.
Wunian, to dwell; *wont*.
Wyrt, root; *mugwort*, *liverwort*.

LATIN ROOTS WITH ENGLISH DERIVATIVES.

Acer, sharp; *acrid*.
Acidus, sour; *acid*.
Acuo, I sharpen; *acute*.
Aedes, a house; *edifice*, *edify*.
Aequus, equal; *equality*.
Aether, the sky; *ethere*al.
Aevum, an age; co*ev*al.
Ager, a field; *agri*culture.
Agger, a heap; ex*agger*ate.
Ago, actum, I do; *agent*, *agitate*.
Alăcer, cheerful; *alacrity*.
Aliēnus, other's; *alien*.
Alo, I nourish; *ali*ment.
Alter, another; *alternate*.
Altus, high; ex*alt*, *alt*itude.
Amo, I love; *am*iable, *amicable*.
Amplus, large; *amplify*.
Ango, I vex; *anger*, *anx*iety.
Angŭlus, a corner; *angul*ar, *angle*.
Anĭmus, mind; *anim*ate, *animosity*.
Annus, a year; *ann*als, *annu*al.
Antīquus, ancient; *antic*, *antiquity*.
Aperio, apertum, I open; *aper*ture.
Apto, I fit; ad*apt*ation.
Aqua, water; *aqua*tic.
Arbĭter, a judge; *arbitrary*.
Arbor, a tree; *arbour*, *arbor*aceous.
Arceo, I drive away; co*erc*ion.
Arma, arms; *army*, *armour*.
Aro, I plough; *ar*able.
Ars, art; *art*ful, *artist*.
Artus, the joints; *arti*culate.
Asper, rough; ex*asper*ate.
Audio, auditum, I hear; *audi*ence.
Augeo, auctum, I increase; *aug*ment, *auth*or.
Auris, the ear; *auricle*.
Auspex, a soothsayer; *auspic*ious.
Avarus, greedy; *avarice*.
Avis, a bird; *aviary*.
Barba, a beard; *barber*.
Beatus, blessed; *beat*itude.
Bellum, war; re*bel*.
Bellus, beautiful; em*bell*ish.
Bene, well; *bene*diction.
Bĭbo, I drink; im*bibe*.
Bilis, bile; *antebilious*.
Bini, two by two; *combine*.
Bis, twice; *bi*ped.
Brevis, short; *brev*ity.
Cado, casum, I fall; *casual*, ac*cid*ent.
Cædo, cæsum, I cut; *decide*, *suicide*, *homicide*.
Calor, heat; *calor*ic.
Calx, calcis, lime; *calc*areous.
Candeo (censum, in comp.), I shine; *candle*, *incense*.
Canis, a dog; *can*ine.
Cano, I sing; *cant*icles.
Capillus, hair; *capill*ary.
Capio (ceptum, in comp.), I take; *capable*, *except*.
Caput, capĭtis, the head; *capit*al, pre*cipit*ate.
Carbo, a coal; *carbon*.
Carcer, a prison; in*carcer*ate.
Caro, carnis, flesh; *carnal*, *carn*ivorous.
Cartilago, a gristle; *cartilaginous*.
Carus, dear; *caress*.
Cavus, hollow; con*cav*e.
Cedo, cessum, I go or yield; *antecedent*, *recede*.
Celer, swift; *celer*ity.
Cella, a cellar; *cell*.
Centrum, the middle; *centre*.
Centum, a hundred; *century*.
Cerno, cretum, I perceive; *discern*, *discreet*.
Certus, certain; *certify*.
Charta, paper; *chart*, *charter*.
Chorda, a string; *chord*.
Cinctus, girt about; pre*cincts*.
Cito, I summon; *cite*, *cit*ation.
Civis, a citizen; *civil*, *civi*lize.
Clamo, I cry out; pro*claim*, *clamour*.
Clarus, clear; de*clare*, *clarify*.
Claudo, clausum, I shut; *clause*, *exclude*.
Clemens, merciful; *clemency*.

Clino, I bend; re*cline*.
Clivus, a slope; de*clivity*.
Coelum, heaven; *celes*tial.
Colo, cultum, I cultivate; *colony*, *cultivate*.
Comes, a companion; con*comitant*.
Convexus, crooked; *convex*.
Copia, plenty; *copi*ous.
Coquo, coctum, I boil; *decoction*.
Cor, the heart; con*cord*, *core*.
Cornu, a horn; uni*corn*, *cornet*.
Corona, a crown; *corolla*.
Corpus, the body; in*corpor*ate, *corpse*.
Cras, to-morrow; pro*cras*tinate.
Credo, I trust; *credit*, *cred*ulous.
Cresco, I grow; in*crease*, *crescent*.
Crimen, a charge; *crimin*al.
Crux, a cross; *cruci*fy.
Cubo (cumbo, comp.), I lie; *cub*, in*cumb*ent, *accubation*.
Culpa, a fault; *culp*able, *exculpate*.
Cumŭlus, a heap; ac*cumul*ate.
Cura, care; sine*cure*, *cure*.
Curro, cursum, I run; in*cur*, ex*curs*ion.
Curtus, short; *curt*ail.
Curvus, crooked; *curve*.
Cutis, the skin; *cuti*cle.
Damno, I condemn; *damn*able, con*demn*.
Decor, decŏris, grace, beauty; *decor*ous, *decor*ate.
Dens, dentis, a tooth; *dentist*, *indent*.
Densus, thick; *dense*, con*dense*.
Deus, a god; *Dei*ty, *dei*fy.
Dexter, right-handed; *dexterity*, *dexterous*.
Dico, dictum, I say; *dict*ate, pre*dict*.
Dies, day; *di*al, *di*ary, *diurnal*.
Dignus, worthy; *dign*ity.
Divido, divisum, I divide; *devise*.
Do, datum, I give; *addition*, *date*.
Doceo, doctum, I teach; *docile*, *doct*or.
Doleo, I grieve; con*dole*.
Dolor, grief; *dolor*ous.
Domĭnus, a master; *domin*eer.
Domus, a house; *dom*estic.
Duco, ductum, I lead; in*duce*, aque*duct*.
Duo, two; *du*el, *duet*.
Durus, hard; *dur*able.
Edo, I eat; *ed*ible.
Ego, I; *ego*tist.
Emo, emptum, I buy; red*eem*, ex*empt*ion.
Emŭlus, a rival; *emul*ation.
Eo, itum, I go; *circuit*, *exit*.
Erro, I wander; *err*, ab*err*ation.
Exter, outward; *extern*al.
Facĭlis, easy; *facil*itate, dif*ficulty*.
Facio, factum, I make; *facility*, *factor*.
Fallo, I deceive; in*fall*ible.
Fames, hunger; *fam*ine.
Fanum, a temple; pro*fane*.
Fari, fatus, to speak; *fate*, *fable*.
Felix, felĭcis, happy; *felic*ity.
Femĭna, a woman; *feminine*.
Fero, latum, I carry; *ferry*, *confer*.
Ferveo, I boil; *ferv*id, *effervesce*.
Fido, I trust; con*fide*, *fidelity*.
Filius, son; *fil*ial, af*filiate*.
Filum, a thread; *fil*ament.
Fingo, fictum, I feign; *fiction*.
Finis, an end; *fin*al, *fin*ite.
Firmus, strong; con*firm*.
Fiscus, a bag or purse; *fisc*al, con*fisc*ate.
Flagro, I burn; con*flagr*ation.
Flatus, a puff of wind; in*flat*ion, *flatulent*.
Flecto, flexum, I bend; re*flect*, *flexible*.
Fligo, flictum, I beat; *conflict*.
Flos, floris, a flower; *florist*, *flor*al.
Fluo, fluxum, I flow; *fluent*, *fluctuate*.
Fodio, fossum, I dig; *fossil*.
Foecundus, fruitful; *fecund*.
Foedus, a treaty; con*feder*ate.
Folium, a leaf; *foliage*.
Follis, a bag; *follicle*.
Foro, I bore; per*for*ate.
Fortis, strong; *fort*, *forti*fy.
Frango, fractum, I break, *fragile*, *fraction*.
Frater, a brother; *fratern*al.
Frico, I rub; *friction*.
Frigeo, I am cold; *frig*id.
Frons, the forehead; *front*, af*front*.
Fruor, I enjoy; *fru*ition, *fructify*.
Frustra, in vain; *frustr*ate.
Fugio, I flee; re*fuge*.
Fulgeo, I shine; re*fulg*ent.
Fumus, smoke; per*fume*, *fum*igate.
Fundo, I pour out; re*fund*.
Fundus, the bottom; *fundamental*.
Fungor, functus, I perform; *function*.
Gelu, frost; con*geal*.
Gens, gentis, a nation; *gentile*.
Genus, genĕris, a kind; de*gener*ate.
Germen, germĭnis, a bud; *germin*ate.
Gero, gestum, I carry; *gest*ure.

Gigas, gigantis, a giant; *gigan*tic.
Gigno, genitum, I beget; pro*geny*.
Glans, an acorn; *gland*.
Glomus, glomĕris, a clew; *conglomerate*.
Gluten, glue; *glutinous*.
Gradior, gressus, I go; retro*grade*, ag*gress*ion.
Grandis, great; *aggrandize*.
Gratia, favour; *gratuitous*, *grace*.
Gravis, heavy; *gravity*.
Grex, gregis, a flock; *greg*arious.
Gula, the throat; *gullet*, *gully*.
Gusto, I taste; dis*gust*.
Habeo, habitum, I have; in*habit*, *habit*.
Haereo, I stick; ad*here*.
Haeres, haerēdis, an heir; *hered*itary.
Halo, I breathe; ex*hale*.
Haurio, haustum, I draw; ex*haust*.
Herba, an herb; *herbage*.
Hilăris, cheerful; ex*hilar*ate.
Homo, a man; *human*, *humanity*.
Hora, an hour; *horary*.
Hortor, I exhort; ex*hort*.
Hospes, hospĭtis, a guest; *hospit*able.
Hostis, an enemy; *host*ile.
Humĭdus, moist; *humid*.
Humus, the ground; post*hum*ous.
Idem, the same; *iden*tity.
Ignis, fire; *ign*eous.
Imăgo, an image; *image*.
Imperium, power; *imper*ial.
Index, indĭcis, a discoverer; *indic*ate.
Infra, below; *infern*al.
Ingenium, natural disposition; *ingeni*ous.
Initium, a beginning; *initi*ate.
Insŭla, an island; pen*insula*, *insular*.
Intus, intra, within; *intern*al.
Ira, anger; *ire*, *irr*itable.
Iter, itinĕris, a journey; *itiner*ate.
Jaceo, I lie; ad*jac*ent.
Jacio (jectum in comp.), I throw; *abject*, *inject*.
Janua, a gate; *jan*itor, *January*.
Jubĭlum, a shout of joy; *jubil*ee.
Judex, judĭcis, a judge; *judic*ial.
Jugum, a yoke; con*jug*al.
Jungo, junctum, I join; *juncture*, *adjunct*.
Juro, I swear; con*jure*.
Jus, juris, right, law; *juris*diction, *justice*.
Juvĕnis, a youth; *juven*ile.
Juvo, jutum, I help; *adjutant*.

Labor, lapsus, I fall; *lapse*, *relapse*.
Lacer, torn; *lacer*ate.
Laedo (lisum in comp.), I hurt; *collision*.
Lambo, I lick; *lamb*ent.
Lamĭna, a thin plate; *laminated*.
Lapis, lapĭdis, a stone; di*lapid*ate.
Latus, wide; di*late*.
Latus, latĕris, a side; *later*al.
Laus, laudis, praise; *laud*able.
Lavo, I wash; *lave*.
Laxus, loose; re*lax*.
Lego, legatum, I send; *delegate*, *legacy*.
Lego, I gather; al*lege*.
Lenis, gentle; *len*ity.
Lentus, slow; re*lent*.
Levo, I lift up; *elevate*, *lever*, *levity*.
Lex, legis, a law; *legis*late, *leg*al.
Liber, a book; *library*, *libel*.
Liber, free; *liberty*, *liber*al.
Libra, a balance; equi*libr*ium.
Licet, it is lawful; il*licit*.
Lignum, wood; *ligne*ous.
Ligo, I bind; *liga*ment.
Limen, the threshold; *eliminate*.
Linea, a line; *linea*ment.
Linquo, I leave; re*linqu*ish.
Liqueo, I melt; *liquid*.
Lis, litis, strife; *liti*gate.
Litĕra, a letter; *liter*al.
Locus, a place; *loc*ality, *local*.
Longus, long; *long*itude.
Loquor, locutus, I speak; *loqu*acity, *elocution*.
Lucrum, gain; *lucr*ative, *lucre*.
Luctor, I struggle; *reluct*ant.
Ludo, lusum, I play; *ludi*crous, il*lus*ion.
Lumen, lumĭnis, light; *lumin*ary.
Luna, the moon; *luna*tic, sub*lunary*.
Luo, I wash; di*lute*, al*luv*ial.
Lustro, I purify; *lustre*, il*lustr*ate.
Lux, lucis, light; *luc*id.
Macer, lean; e*maci*ate.
Macŭla, a spot; im*macul*ate.
Magnus, great; *magnify*.
Major, greater; *major*ity.
Malus, bad; *male*volent.
Malleus, a hammer; *mall*et, *malle*able.
Mamma, a breast; *mammal*ia.
Mando, I bid; com*mand*, *mand*ate.
Mando, I chew; *mand*ible, *manger*.
Maneo, I stay; per*man*ent.
Mano, I flow; e*mana*te.
Manus, a hand; *manual*.

Mare, the sea; *marine, maritime.*
Mars, martis, the god of war; *martial.*
Mater, matris, a mother; *maternal, matrimony.*
Matūrus, ripe; *maturity.*
Medius, middle; *mediator, medium.*
Melior, better; *ameliorate.*
Memor, mindful; *memorable.*
Mens, mentis, the mind; *mental.*
Mergo, mersum, I plunge; *emerge, immersion.*
Mereor, meritus, I deserve; *meritorious.*
Merx, mercis, merchandise; *commerce.*
Metior, mensus, I measure; *mete.*
Mico, I shine; *emication.*
Migro, I remove; *migrate.*
Miles, milĭtis, a soldier; *militant.*
Mille, a thousand; *millennium.*
Minister, a servant; *administer.*
Minor, less; *minor, minority.*
Minuo, I lessen; *diminution, diminish.*
Miror, I gaze; *mirror, admire.*
Miser, wretched; *miserable*
Mitis, mild; *mitigate.*
Mitto, I send; *remit.*
Modus, a measure; *mode, modify.*
Mola, a millstone; *emolument.*
Moles, a mass; *molest.*
Mollis, soft; *mollify.*
Moneo, I warn; *admonish.*
Monstro, I point out; *demonstrate.*
Mors, mortis, death; *mortal.*
Mos, moris, a manner; *moral.*
Moveo, motum, I move; *remote.*
Mucus, slimy matter; *mucilaginous.*
Multus, many; *multiply.*
Munio, I fortify; *munition.*
Munus, munĕris, a gift; *remunerate.*
Murus, a wall; *mural, immure.*
Musculus, a tendon; *muscle.*
Muto, I change; *mutable.*
Nasus, the nose; *nasal.*
Nascor, natus, I am born; *nascent, natal.*
Navis, a ship; *naval, navigate.*
Necto, I tie; *connect.*
Nego, I deny; *negative.*
Negotium, a thing; *negotiate.*
Nervus, a sinew; *enervate.*
Neuter, neither; *neutral.*
Niger, black; *negro.*
Nihil, nothing; *annihilate.*
Noceo, I hurt; *innocent, noxious.*
Nomen, nominis, a name; *denominate.*
Norma, a rule; *enormous.*
Nosco, notum, I know; *note, recognise.*
Novus, new; *novel, renovate.*
Nox, noctis, night; *nocturnal.*
Nubo, I marry; *connubial.*
Nudus, naked; *denude.*
Nullus, none; *annul.*
Numĕrus, a number; *numeral.*
Nuntio, I tell; *announce.*
Nutrio, I nourish; *nutriment.*
Obliquus, aslant; *obliquity.*
Oblivio, forgetfulness; *oblivion.*
Octo, eight; *octagon, octave.*
Ocŭlus, the eye; *oculist.*
Odium, hatred; *odious.*
Odor, smell; *odoriferous.*
Oleo, I smell; *redolent.*
Omnis, all; *omnipotent.*
Onus, a burden; *onerous, exonerate.*
Opācus, dark; *opacity, opaque.*
Opto, I wish; *adopt, option.*
Opus, a work; *operation.*
Orbis, a circle; *orbit.*
Ordo, order; *ordain.*
Orior, I rise; *oriental.*
Orno, I adorn; *ornament.*
Oro, I beg; *oral, orator.*
Os, a bone; *ossify.*
Oscillo, I move backwards and forwards; *oscillate.*
Ovum, an egg; *oval.*
Pando, I spread; *expand.*
Par, equal; *parity.*
Pareo, I appear; *apparent.*
Pario, I produce; *parent.*
Paro, I prepare; *repair.*
Pasco, pastum, I feed; *pastor.*
Pater, a father; *paternal.*
Patior, passus, I suffer; *patient, patriot.*
Pauci, few; *paucity.*
Pauper, poor; *pauperism.*
Pax, pacis, peace; *pacific, pacify.*
Pectus, the breast; *expectorate.*
Pecunia, money; *pecuniary.*
Pellis, a skin; *pellicle, peel.*
Pello, pulsum, I drive away; *expel.*
Pendeo, pensum, I hang; *depend.*
Pendo, pensum, I weigh or pay; *compensate.*
Pene, almost; *peninsula.*
Penetro, I pierce; *penetrate.*
Perior, peritus, I try; *experiment.*

Pes, pedis, the foot: *pedestal.*
Peto, I seek; *petition.*
Pingo, pictum, I paint: de*pict*, *Picts.*
Pio, I atone for: ex*piate.*
Piscis, a fish: *expiscate.*
Pistillum, a pestle: *pistil.*
Pius, pious: *piety.*
Placeo, I please: *placid.*
Placo, I appease: *placable.*
Planus, plain: *plano-convex.*
Plaudo, I clap hands: *applaud.*
Plebs, the common people: *plebeian.*
Plenus, full: re*plenish.*
Pleo, pletum, I fill: *complete.*
Plico, I fold: com*plicate.*
Ploro, I wail: de*plore.*
Plumbum, lead: *plumber.*
Plumula, a little feather: *plumule.*
Pœna, punishment: *penal.*
Pollen, fine flour: *pollen.*
Polus, the pole: *polar.*
Pono, I place: de*pone.*
Popŭlus, the people: *popular.*
Porto, I carry: ex*port*, *port*able.
Potens, powerful: *potent*ate.
Præda, plunder: *preda*tory.
Pravus, wicked: de*pravity.*
Precor, I pray: de*precate.*
Prehendo, I take: ap*prehend.*
Premo, pressum, I press: *compress.*
Pretium, a price: ap*preciate.*
Primus, first: *primary.*
Privo, I take away: de*prive.*
Probo, I prove: *prob*able.
Probus, good: *probity.*
Propago, I cut down: *propagate.*
Proprius, one's own: ap*propriate.*
Pudens, bashful: im*pudent.*
Puer, a boy: *puer*ile.
Pugna, a fight: *pugna*cious.
Pulvis, dust: *pulverize.*
Punctum, a point: *punct*uation.
Pungo, I prick: *pung*ent.
Pupula, the apple of the eye: *pupil.*
Puto, I lop, I think: am*putate.*
Putris, rotten: *putre*faction.
Quaero, I ask: *query.*
Quatuor, four: *quadruped.*
Queror, I complain: *quer*ulous.
Quinque, five: *quinqu*ennial.
Radius, a ray: *radi*ate.
Radix, a root: *radical.*
Rado, rasum, I scrape: *erase.*
Ramus, a branch: *ramify.*
Rapio, raptum, I seize: *rapacious*, *rapine.*
Rarus, scarce: *rarity*, *rarefy.*
Ratio, reason: *rational.*
Recens, new: *recent.*
Rectus, straight: *recti*lineal.
Rego, I rule: *regal*, *rector.*
Res, a thing: *reality.*
Rete, a net: *retina.*
Rideo, I laugh at: de*ride.*
Rigeo, I am stiff: *rigid.*
Rigo, I water: ir*rig*ate.
Robur, oak, strength: cor*robor*ate.
Rodo, I gnaw: cor*rode.*
Rota, a wheel: *rota*tion.
Rumen, the throat: *ruminate.*
Rumpo, ruptum, I break: e*rupt*ion.
Rus, the country: *rus*tic, *rural.*
Sacer, sacred: *sacri*fice.
Sagax, wise: *sage.*
Sal, salt: *sal*ine, *salary.*
Salio, I leap: *sali*ent, *salmon.*
Saliva, spittle: *salivary.*
Salvus, safe: *salva*tion.
Sanctus, holy: *sanctify.*
Sanguis, blood: *sanguin*ary.
Sanus, sound: *sane*, in*san*ity.
Sapio, I taste: *sap*id, in*sip*id.
Satis, enough: *satis*fy.
Satur, full: *satur*ate.
Scando, I climb: *scan*, *ascend.*
Scindo, I cut: re*scind.*
Scio, I know: *scie*nce.
Scribo, I write: in*scribe.*
Scrutor, I search diligently: *scrut*iny.
Sculpo, I carve: *sculpture.*
Seco, sectum, I cut: dis*sect.*
Secundus, second: *secondary.*
Sedeo, I sit: *sed*entary.
Semen, seed: *semi*nary, dis*semin*ate.
Semi, half: *semi*circle.
Senex, old: *senior.*
Sentio, I feel: *sent*ient.
Sepio, septum, I enclose: *transept.*
Sepultus, buried: *sepul*chre.
Sequor, I follow: sub*sequent.*
Servo, I keep: preserve.
Sidus, a star: *sider*eal.
Signum, a sign: *signal.*
Silex, flint: *silicious.*
Silva, a wood: *silvan*, *savage.*
Similis, like: *simi*lar.
Simul, at the same time; *simultane*ous.

Simŭlo, I feign; dissimulation.
Sisto, I stop; assist, desist.
Socius, a companion; social.
Sol, the sun; solar, parasol.
Solor, I comfort; console.
Solus, alone; sole, solitude.
Solvo, solutum, I loose; dissolve, solution.
Sono, I sound; sonorous.
Sopor, a deep sleep; soporific.
Sorbeo, I suck in; absorb.
Sors, a lot; assort.
Spargo, sparsum, I spread; asperse.
Spatium, space; spacious, expatiate.
Species, a form; specific.
Specio, spectum, I look at; species, aspect.
Spina, a thorn; spine.
Spiro, I breathe: conspire, expire.
Spolium, plunder: spoil, spoliation.
Spondeo, I promise; respond.
Spongia, a sponge; sponge.
Sponte, of one's own accord; spontaneous.
Statuo, I set up; statue, constitute.
Stella, a star; constellation.
Sterĭlis, barren; sterile, sterility.
Sterno, I throw down; consternation.
Stigma, a mark or brand; stigmatize.
Stillo, I drop; distil.
Stimŭlus, a spur; stimulate.
Stinguo, stinctum, I put out; extinct, extinguish.
Stipŭla, a straw; stipulate.
Stirps, the trunk of a tree; extirpate.
Sto, I stand; stature, stagnant.
Stringo, I bind; stringent, strict.
Struo, structum, I build; structure, destroy.
Stultus, foolish; stultify.
Stylus, a pin; style.
Suadeo, suasum, I advise; dissuade, persuasion.
Suavis, sweet; suavity.
Sugo, suctum, I suck; suction.
Sulphur, brimstone; sulphuric.
Summus, highest; summit.
Sumo, sumptum, I take; assume.
Surgo, surrectum, I rise; insurgent, resurrection.
Tacĭtus, silent; tacit, taciturn.
Tango, tactum, I touch; tangent, contact.
Tardus, slow; retard.
Tego, tectum, I cover; protect, integument.
Temno, I despise; contemn.
Templum, a temple; contemplate.
Tempus, tempŏris, time; temporal.
Tendo, tensum, tentum, I stretch; distend, extent, intense.
Teneo, tentum, I hold; contain.
Tento, I try; tentative.
Tenuis, thin; tenuity, attenuate.
Tepidus, warm; tepid.
Terminus, a boundary; termination.
Tero, tritum, I rub; contrite.
Terra, the earth; terrestrial.
Tertius, third; tertiary.
Testis, a witness; testify, attest.
Texo, textum, I weave; texture.
Thorax, the breast; thoracic.
Tollo, I lift up; extol.
Torreo, I roast; torrid.
Torqueo, tortum, I twist; extort.
Totus, the whole; total.
Tracto, I handle; tractable.
Traho, tractum, I draw; extract.
Tremo, I tremble; tremulous.
Tribuo, tributum, I give; distribute.
Trudo, I thrust; intrude.
Tuber, a bump; protuberance.
Tubus, a tube; tubular.
Tueor, I see; tuition, intuitive.
Tumeo, I swell; tumour, tumult.
Turba, a crowd; turbulent.
Turgeo, I swell; turgid.
Turpis, base; turpitude.
Uber, fertile; exuberant.
Ultimus, last; ultimate.
Umbra, a shadow; umbrella.
Unda, a wave; undulate.
Unguo, unctum, I anoint; unguent.
Unus, one; uniform, unit.
Urbs, a city; urbanity.
Uro, ustum, I burn; combustion.
Utĭlis, useful; utility.
Vacca, a cow; vaccination.
Vaco, I am empty; vacation, evacuate, vacuum.
Vado, I go; invade, wade.
Vagor, I wander; vagrant.
Valeo, I am strong; prevalent.
Vallum, rampart; interval.
Valvae, folding-doors; valve.
Vas, vessel; vase.
Vasto, I lay waste; devastation.
Veho, I carry; vehicle.
Vello, vulsum, I pull; convulse.
Velox, swift; velocity.
Vena, a blood-vessel; vein.
Venio, ventum, I come; advent.

Venter, the belly; *ventriloquism*.
Ver, the spring; *vernal*.
Vergo, I incline; di*verge*.
Vertex, the top; *vertical*.
Verto, versum, I turn; *avert*.
Verus, true; *aver*, *verity*.
Vestis, a garment; in*vest*.
Vetus, old; *veteran*.
Via, a way; *deviate*, ob*vious*.
Vibro, I shake; *vibrate*.
Vicīnus, neighbouring; *vicin*ity.
Video, visum, I see; *visible*.
Vigil, watchful; *vigil*ant.
Vinco, I conquer; in*vin*cible.
Vindex, defender; *vindicate*.
Virus, poison; *virulent*.
Viscus, bird-lime; *viscid*.
Vita, life; *vital*.
Vivo, I live; sur*vive*.
Voco, I call; re*vok*e.
Volo, I will; *vol*untary.
Volo, I fly; *vol*atile.
Volvo, volutum, I roll; *evolve*.
Voro, I devour; *vora*cious.
Voveo, votum, I vow; *vote*.
Vox, vocis, the voice; *vocal*.
Vulcanus, the god of fire; *volcano*.
Vulgus, the rabble; *vulg*ar.

GREEK ROOTS WITH ENGLISH DERIVATIVES.

Achos, pain; *ache*.
Aër, the air; *aërial*.
Agōgos, a leader; dem*agogue*.
Akouo, I hear; *acous*tics.
Allēlōn, each other; *parallel*.
Aner, andros, a man; *monandria*.
Angello, I tell; ev*angel*ist.
Anthos, a flower; *antho*logy.
Anthrōpos, a man; phil*anthropy*.
Archo, I rule or begin; *monarch*, hep-*tarchy*, *arch*bishop.
Arctos, a bear, the north; *arct*ic.
Aristos, best; *aristo*cracy.
Arithmos, number; *arithme*tic.
Arōma, odour; *aroma*tic.
Asthma, breath; *asthma*tic.
Astron, a star; *astro*nomy.
Athletes, a wrestler; *athletic*.
Atmos, vapour; *atmo*sphere.
Autos, one's self; *auto*graph.
Ballo, I throw; *parable*.
Bapto, I dip; *bapt*ism.
Baros, weight; *baro*meter.
Basis, the bottom; *base*.
Biblos, a book; *bible*.
Bios, life; *bio*graphy.
Bolbos, an onion; *bulb*ous.
Botané, an herb; *botany*.
Chalyps, chalўbos, steel; *chaly*beate.
Charis, love; eu*charist*.
Cheir, the hand; *surgeon*.
Chloros, green; *chloride*.
Cholé, bile; *chole*ric.
Christos, anointed; *Christ*.
Chronos, time; *chrono*meter.
Chrysos, gold; *chrysolis*.
Chylos, juice; *chyle*.
Chymos, juice; *chyme*.
Daktўlos, a finger; *dactyl*.
Deka, ten; *deca*logue.
Demos, the people; epi*dem*ic.
Dendron, a tree; rhodo*dendron*.
Despōtes, a lord; *despot*ic.
Dotos, given; *anecdote*.
Doxa, opinion; *orthodox*.
Dromos, a race; *drom*edary.
Drus, an oak; *dru*id, *dry*ad.
Dynămis, power; *dynam*ics.
Ecleipo, I fail; *eclip*tic, *eclipse*.
Eidos, a form; *idol*, *cycloid*.
Eiron, a dissembler; *irony*.
Ekklesia, the church; *ecclesiastic*.
Elao, I drive; *elastic*.
Entoma, insects; *entomology*.
Epitŏmé, an abridgment; *epitom*ize.
Epos, a word; *ep*ic, ortho*epy*.
Erēmos, a desert; *hermit*.
Ergon, work; en*erg*etic.
Ethos, a custom; *eth*ics.
Eu, well; *eu*logy.
Gala, milk; *galaxy*.
Gamos, a marriage; bi*gamy*.
Gaster, the belly; *gast*ric.
Gé, the earth; *geo*graphy.
Gennao, I produce; *oxygen*.
Glossa, glotta, the tongue; *gloss*ary.
Glupho, I carve; hiero*glyph*ics.
Gonia, a corner, an angle; poly*gon*.
Gramma, a letter; *grammar*, *telegram*.
Grapho, I write; auto*graph*.
Gumnos, naked; *gymnastics*.
Gunè, a woman; mono*gyn*ia.
Haima, blood; *emerods*.
Hedra, a seat; *cathedral*.

Helios, the sun; ap*helion*.
Hemĕra, a day; ep*hemeral*.
Hemĭsus, half; *hemi*sphere.
Hepta, seven; *hepta*gon.
Hetĕros, different; *hetero*dox.
Hex, six; *hexa*gon.
Hiĕros, holy; *hier*archy.
Hippos, a horse; *hippo*potamus.
Hodos, a way; ex*odus*.
Holos, the whole; cat*holic*.
Homos, similar; *homo*logous.
Hudor, water; *hydro*statics.
Ichnos, a footstep; *ichnography*.
Isos, equal; *isosceles*.
Kakos, bad; *caco*phony.
Kalcs, handsome; *kaleido*scope.
Kalypto, I cover; apo*calypse*.
Kalyx, a cup; *calyx*.
Kausis, a burning; *caustic*.
Komos, an ode; *comedy*.
Kratos, strength; aristo*cracy*.
Kreas, flesh; *pancreatic*.
Kryptos, hidden; *crypt*.
Krystallos, ice; *crystal*.
Kyklos, a circle; *cycle*.
Kylindo, I roll; *cylinder*.
Kyon, a dog; *cyn*ic.
Laos, the people; *la*ity.
Lithos, a stone; *litho*graphy.
Logos, a word; cata*logue*.
Lusis, a loosening; *analize*.
Malasso, I soften; *malgam*.
Mania, madness; *maniac*.
Martyr, a witness; *martyr*.
Mathema, science; *mathe*matics.
Mechanê, a machine; *mechan*ic.
Melan, black; *melan*choly.
Melos, a song; *melody*.
Meter, a mother; *metropolis*.
Meteoros, lofty; *meteor*.
Metron, a measure; geo*metry*.
Micros, little; *micro*scope.
Misos, hatred; *mis*anthrope.
Monos, alone; *mono*syllable.
Morphê, shape; meta*morph*osis.
Mythos, a fable; *mytho*logy.
Naus, a ship; *nau*tical.
Nekros, dead; *necro*mancy.
Neos, new; *neo*logy.
Nesos, an island; Pelopon*nesus*.
Nomos, a law; astro*nomy*.
Octo, eight; *octave*.
Odê, a song; *melody*, come*dy*.
Oikos, a house; *eco*nomy.
Olĭgos, few; *olig*archy.
Oōn, an egg; *oolite*.
Optŏmai, I see; *opti*cal.
Organon, an instrument; *organic*.
Ornis, ornīthos, a bird; *ornitho*logy.
Orthos, right; *ortho*graphy.
Oxys, acid; *oxy*gen.
Pais, paidos, a boy; *peda*gogue.
Pas, pan, all; *panoply*.
Pathos, feeling; *pathetic*.
Pentê, five; *penta*gon.
Petalon, a leaf; *petal*.
Petra, a stone; *petri*faction.
Phaino, I appear; *pheno*menon.
Phemi, I speak; blas*pheme*.
Philos, a friend; *philo*sophy.
Phobeo, I terrify; hydro*phobi*a.
Phonê, a sound; eu*phony*.
Phren, the mind; *frenzy*.
Phthongos, a sound; di*phthong*.
Physis, nature; *phys*ical.
Phyton, a plant; *zoophyte*.
Polĕmos, war; *polem*ical.
Poleo, I sell; biblio*pole*.
Polis, a city; metro*polis*.
Polys, many; *poly*gon.
Poros, a passage; *pore*.
Potămos, a river; hippo*potamus*.
Pous, podos, the foot; anti*podes*.
Presbutĕros, older; *presbyter*ian.
Pteron, a wing; a*ptera*.
Pyr, fire; *pyramid*.
Sarks, sarkos, flesh; *sarco*phagus.
Schizo, I divide; *schism*.
Scleros, hard; *sclerotic*.
Selēnê, the moon; *selenite*.
Sitos, corn, food; para*site*.
Skopeo, I see; tele*scope*.
Sophos, wise; philo*sopher*.
Sphaira, a globe; *sphere*.
Spora, a seed; *spore*.
Stalazo, I drop; *stalactite*.
Stello, I send; apo*stle*.
Stereos, solid; *stereotype*.
Sukon, a fig; *sycophant*.
Taphos, a tomb; *epitaph*.
Technê, art; *techn*ical.
Telê, distant; *tele*scope.
Temno, I cut; *atom*.
Tēreo, I keep; *artery*.
Theoreo, I see; *theor*y.
Theos, God; a*the*ist.
Thermos, warm; *thermo*meter.
Thesis, a placing; hypo*thesis*.
Topos, a place; *topo*graphy.
Zoon, an animal; *zoo*logy.